



IPMT Specification – Piping  
PIPING MATERIAL CLASS SERVICE INDEX AND GENERAL  
NOTES

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Wood Contract No:	7650
Client Name:	INEOS
Project Title:	Project One
Project Location:	Antwerp, Belgium

Revision	A12	Signature	A13	Signature	A14	Signature
DATE	2 Mar 2022		7 Jul 2022		17 Nov 2022	
Originator:	D Crosland	DC	D Crosland	DC	D Crosland	<div>DocuSigned by: Daniel Crosland 921FC7C88F5F483... 22 November 2022   03:11 PST</div>
Checked:	P Morrell	PM	P Morrell	PM	P Van Damme	<div>DocuSigned by: Piet Van Damme 37F32B84AAB643D... 22 November 2022   03:07 PST</div>
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Approved: Mechanical Engineer	P Clymans	PC	P Clymans	PC	P Clymans	<div>DocuSigned by: Peter Clymans 3B37942FA95840F... 22 november 2022   08:46 PST</div>



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Section	Summary of Change	Revision number
ATT 1	Size 36" added to pipe class A3AN3 as requested by Contractor in TQ-ECR-TFT-PDT-PIP-060-0.	A13
ATT 1	Pipe class B3AN3 maximum temperature increased to 210°C and requirement for external pressure changed from PV to FV, as requested by Contractor in TQ-ECR-TFT-PDT-ENG-055-0.	A13
5.5	Referenced specification corrected from 7650-8230-SP-100-0023 to 7650-8230-SP-100-0024.	A13
ATT 1	Filled in column on permissible ASME B31.3 Fluid Categories for pipe classes and added a legend for the abbreviations used.	A13
5.22	Corrected API 609 Table references 3B and 3C (in accordance with TQ-ECR-TRT-INT-8240-001-0).	A13
ATT 1	Note 21 changed specification to 7650-8440-SP-100-0019 from API RP 941.	A13
ATT 1	Fluid Codes "SC5", "WBF", "WDS" added to pipe class A0JD as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
ATT 1	Fluid Code "ERE" added to pipe class B1DH2 as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
ATT 1	Fluid Code "H99" added to pipe class B0JP3 as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
ATT 1	Fluid code "PC3H6" added to B0JZ3 as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
ATT 1	Fluid Code "ERE" added to pipe class B3DS as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
ATT 1	Fluid Code "ERE" added to pipe class B0MH3 as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
ATT 1	Fluid Codes "FGW", "FLW", "PC5PL", "PPO", "PV" added to pipe class A3AP3 as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
ATT 1	Fluid Code "PC5PL" added to pipe class B1GP3 as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
ATT 1	Fluid Code "H80" added to pipe class A3AP3 as requested in TQ-ECR-TFT-PDT-ENG-055-1.	A13
4.3	Reference to 7650-8230-SP-100-0017 deleted as specification was cancelled.	A13
ATT 1	Fluid Code "P" removed from pipe class A6AC as is not applicable.	A13
ATT 1	Valve types "GA, GL, CH" added to pipe class B3DS based on request in TQ-ECR-TRT-INT-8240-004-0.	A14



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Section	Summary of Change	Revision number
ATT 1	Pipe class A3AP3 Maximum Design Temperature increased to 425°C as requested by Contractor in TQ-ECR-TFT-PDT-PIP-072-0.	A14
ATT 1	Fluid Code “SC18” added to pipe class B3AS as requested in TQ-ECR-TFT-PDT-PIP-073-0.	A14
ATT 1	Fluid Code “DS” added to pipe class S1RU for specific use-case as requested in TQ-OSB-WDO-PDT-PIP-277.	A14
5.22	Added Note 1 to table of dimensional standards to clarify exception for valves covered by paragraph 4.1.1 of ASME B16.10.	A14
5.22	Table of dimensional standards updated to align with 7650-8230-SP-100-0007 revision A5.	A14

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**1. PURPOSE**

The purpose of this Standard Specification is to list pipe classes identified for the project and general notes relevant to piping material component selection for INEOS Project One located in Antwerp, Belgium.

**2. SCOPE**

This Standard Specification defines the Piping Material Class requirements for the project as per referenced standards and latest engineering practices for use by the FEED and EPC Contractor.

**3. TERMINOLOGY**

The following terms are used throughout the document:

Item	Definition
CONTRACTOR	CONTRACTOR appointed to perform the work. CONTRACTOR is responsible for the placement of PURCHASE ORDERS and management of VENDOR contracts.
Facility	The permanent facilities including the System(s), buildings, structures, civil works, amenities and facilities or any of them which are to be designed, procured, constructed, revamped or refurbished, commissioned and tested as part of the Project
GOODS	Equipment/ material to be provided under the PURCHASE ORDER requirements.
INEOS	Client or its representative
Inspection	The process of measuring, examining, testing, gauging or otherwise comparing the items with the applicable requirements.
IPMT	Integrated Project Management Team
Material Requisition	Referenced by the PURCHASE ORDER to reference the PROJECT technical requirements, Specifications, Data Sheets
May	A permissive statement; an option neither mandatory nor specifically recommended
PURCHASE ORDER	The commercial document issued by CONTRACTOR to VENDOR to indicate types, quantities, and agreed prices for the GOODS
Shall	Designates a requirement which is mandatory. Deviation will require approval via the formal deviation process noted in Technical Queries and Waiver Requests, 7650-8820-PR-100-0030.
Should	A specific recommendation where conformance is not mandatory
SUB VENDOR's	A Sub-Vendor or Sub-Contractor, of any tier, on whom the VENDOR has directly or indirectly placed a Sub-Order.
Surveillance	Surveillance comprises all INEOS activities performed to verify that GOODS meet the specified requirements, including audit, design review, and inspection.
VENDOR	The seller contracted by the PURCHASE ORDER to supply the equipment/ material.

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Item	Definition
Work	All work and services to be performed by CONTRACTOR for INEOS Project One.

#### 4. REFERENCE DOCUMENTS

##### 4.1 General

The latest edition, issue or revision of applicable codes and standards current at the effective date of the contract shall apply. All piping systems shall meet the requirements of this document, other referenced Project Specifications, relevant Codes, Standards and Statutory Regulations (where applicable).

##### 4.2 Codes & Standards

The following international codes and standards shall apply as relevant:

Document No.	Title
<b>American Society of Mechanical Engineers (ASME):</b>	
ASME B31.1	Power Piping
ASME B31.3	Process Piping, 2018
ASME 46.1	Surface Texture
ASME B1.20.1	Pipe Threads General Purpose (Inch)
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.9	Factory-Made Wrought Steel Butt Welding Fittings
ASME B16.10	Face to face and End to End dimension of valves
ASME B16.11	Forged Steel Fittings, Socket-Welding and Threaded
ASME B16.20	Metallic Gaskets for Pipe Flanges
ASME B16.21	Non-Metallic Gaskets for Pipe Flanges
ASME B16.25	Butt-Welding Ends for Pipe, Flanges and Fittings
ASME B16.34	Steel Valves
ASME B16.36	Steel Orifice Flanges
ASME B16.42	Ductile Iron Pipe Flanges and Flanged Fittings
ASME B16.47	Large Diameter Flanges
ASME B16.48	Steel Line Blanks
ASME B36.10M	Welded and Seamless Wrought Steel Pipe.
ASME B36.19M	Stainless Steel Pipe
ASME BPVC Section VIII-1	Boiler & Pressure Vessel Code: Rules for the construction of Pressure Vessels Division 1

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Document No.	Title
ASME BPVC Section VIII-2	Boiler & Pressure Vessel Code: Rules for the construction of Pressure Vessels Division 2 – Alternative Rules
<b>American Petroleum Institute (API):</b>	
API 5L (ISO 3183)	Specification for Line Pipe. Effective 2008, plus addendum 2009
API 594	Check Valves: Flanged, Lug, Wafer and Butt-Welding
API 598	Valve Inspection and Testing
API 599	Metal Plug Valves - Flanged, Threaded and Welding Ends
API 600	Steel Gate Valves-Flanged and Butt-Welding Ends, Bolted Bonnets
API 602	Steel Gate, Globe and check valves for sizes DN100 and smaller for the Petroleum and Natural Gas Industries.
API 608	Metal Ball Valves - Flanged, Threaded and Welding Ends
API 609	Butterfly Valves: Double Flanged, Lug-and Wafer type
API 623	Steel Globe Valves – Flanged and Buttwelding Ends, Bolted Bonnets
API RP 941	Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants
<b>American Society for Testing and Materials:</b>	
ASTM A153	Zinc Coating (Hot Dip) on iron and Steel Hardware
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High Temperature Service
ASTM A182	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves, and Parts for High Temperature Service
ASTM A193	Alloy-Steel and Stainless Steel Bolting Materials for High Temperature Service
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High Temperature Service
ASTM A216	Steel Casting, Carbon, Suitable for Fusion Welding for High Temperature Service
ASTM A217	Steel Casting, Martensitic Stainless and Alloy, for Pressure-Containing Parts Suitable for High Temperature Service
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A240	Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels
ASTM A269	Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A307	Carbon Steel Bolts and Studs, 60,000 PSI Tensile



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Document No.	Title
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A320	Alloy Steel and Stainless Steel Bolting Material for Low Temperature Service
ASTM A333	Seamless and Welded Steel Pipe for Low Temperature Service
ASTM A335	Seamless Ferritic Alloy Steel for High-Temperature Service
ASTM A350	Forgings, Carbon and Low-Alloy Steel Requiring Notch Toughness Testing for Piping Components
ASTM A351	Steel Castings, Austenitic, for High-Temperature Service
ASTM A352	Steel Castings, Ferritic and Martensitic, for Pressure -Containing Parts, Suitable for Low - Temperature Service
ASTM A358	Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High Temperature Service and General Applications
ASTM A370	Mechanical Testing of Steel Products
ASTM A395	Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A403	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A420	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
ASTM A494	Castings, Nickel and Nickel Alloy
ASTM A515	Pressure Vessel Plates, Carbon Steel, for Intermediate and Higher Temperature Service
ASTM A516	Pressure Vessel Plates, Carbon Steel, for Moderate and Lower Temperature Service
ASTM A530	General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM A536	Standard Specification for ductile Iron Casting
ASTM A563	Carbon and Alloy Steel Nuts
ASTM A671	Electric Fusion Welded Steel Pipe for Atmospheric and Low Temperatures
ASTM A672	Electric Fusion Welded Steel Pipe for High Pressure Service at Moderate Temperatures
ASTM A691	Carbon and Alloy Steel Pipe, Electric Fusion Welded for High Pressure Service at High Temperature.
ASTM A999	General Requirements for Alloy and Stainless Steel Pipe
ASTM B61	Valve Bronze Castings
ASTM B62	Composition Bronze or Ounce Metal Castings
ASTM B165	Nickel-Copper Alloy Seamless Pipe and Tube
ASTM B333	Nickel-Molybdenum Alloy Steel Plate, sheet and strip





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Document No.	Title
ASTM B366	Factory-Made Wrought Nickel-Alloy Welding Fittings
ASTM B443	Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet and Strip
ASTM B444	Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625 and UNS N06852) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Pipe and Tube
ASTM B462	Forged or Rolled UNS N08020, UNS N08024, UNS N08026, and UNS N08367 Alloy Pipe Fittings, and Valves and Parts for Corrosive High-Temperature Service
ASTM B463	Forged or Rolled UNS N08020, UNS N08024, UNS N08026 Alloy Plate, Sheet, and Strip
ASTM B494	Specification for Castings, Nickel and Nickel Alloy
ASTM B564	Nickel Alloy Forgings
ASTM B575	Low Carbon Nickel Alloy Plate, Sheet, and Strip
ASTM B619	Welded Nickel and Nickel-Cobalt Alloy pipe
ASTM B622	Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube
ASTM B725	Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper ALLOY (UNS N04400) Pipe
ASTM B729	Seamless Nickel Alloy UNS N08020, UNS N08026, UNS N08024 Pipe & Tube
ASTM B775	General Requirements for Nickel and Nickel Alloy Welded Pipe
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2467	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2996	Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D4024	Machine Made “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Flanges
ASTM F436	Standard Specification for Hardened Steel Washers
<b>American Water Work Association (AWWA):</b>	
AWWA C205	Cement Mortar Protective Lining and Coating
AWWA C207	Steel Pipe Flanges for Waterworks Service
AWWA C208	Dimension for Fabricated Steel Water Pipe Fittings
AWWA C504	Rubber-Seated Butterfly Valves
AWWA C508	Swing Check Valves for Waterworks Service
AWWA C509	Resilient-Seated Gate Valves for Water Supply Service

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Document No.	Title
<b>British Standards:</b>	
BS 1868	Steel Check Valves, Flanged and Butt Welding Ends
BS 1873	Steel Globe Valves, Flanged and Butt Welding Ends
BS 5353	Steel Plug Valves
<b>European Norms (EN):</b>	
EN 558	Industrial Valves – Face-to-face and centre-face dimensions of metal valves for use in flanged pipe systems – PN and Class designated valves
EN 593	Industrial Valves - Metallic butterfly valves for general purposes
EN ISO 15761	Steel gate, globe and check valves for sizes DN 100 and smaller, for the petroleum and natural gas industries
EN ISO 17292	Metal ball valves for petroleum, petrochemical and allied industries
<b>International Organisation for Standardization (ISO):</b>	
ISO17636-1	Non-destructive testing of welds - Radiographic testing - Part 1: X- and gamma-ray techniques with film
ISO17636-2	Non-destructive testing of welds - Radiographic testing - Part 2: X- and gamma-ray techniques with digital detectors
ISO 11971	Visual Examination of Surface Quality Steel casting
ISO 14313	Petroleum and natural Gas Industries, Pipeline Transportation Systems Pipeline valves
ISO 1461	Hot Dip galvanised Coating for Iron and Steel
ISO 3452	Non-Destructive Testing – Penetrant Inspection – General Principles
ISO 4986	Steel magnetic Particle Inspection
ISO 5752	Metal Valves for Use in Flanged Pipe Systems - Face-to-Face and Centre-to-Face Dimensions
ISO/CD 148-1	Metallic Materials Charpy impact Test (V-notch and U-notch)
ISO 14692	Glass-reinforced plastics (GRP) Piping
ISO 15156	Materials for use in H <sub>2</sub> S-containing environments in oil and gas production
<b>Manufacturers Standardization Society (MSS):</b>	
MSS SP25	Standard marking systems for valves and fittings
MSS SP43	Wrought and Fabricated Butt-Welding Fittings for Low Pressure Corrosion Resistance
MSS SP55	Quality Standards for Steel Castings
MSS SP75	Specification for High-Test Wrought Butt Welding Fittings
MSS-SP95	Swaged Nipples and Bull Plugs

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Document No.	Title
MSS SP-97	Integrally Reinforced Branch Outlet Fittings- Socket Welding, Threaded and But Welding Ends.
<b>National Association of Corrosion Engineers (NACE):</b>	
NACE MR0103-2010	Materials Resistant to Sulphide Stress Cracking in Corrosive Petroleum Refining Environments
NACE TM0177-2005	Laboratory testing of Metals for Resistance to Sulphide Stress Corrosion Cracking in H <sub>2</sub> S Environments.
NACE TM0284	Evaluation of Steels for Resistance to HIC
NACE SP0472	Methods and controls to prevent in-service Environmental cracking of Carbon steel Weldments In corrosive petroleum Refinery Environments.
<b>European Directives:</b>	
PED, 2014/68/EU	Pressure Equipment Directive

#### 4.3 Project Standards

The following project standards shall apply as relevant:

Document No.	Title
7650-8230-DS-100-0001	Piping Valve Data Sheets
7650-8230-SP-100-0001	Piping Standard
7650-8230-SP-100-0005	Manual Bulk Valve Isolation Selection Philosophy
7650-8230-SP-100-0006	Standard Assemblies for Vents, Drains and Instrument Connections
7650-8230-SP-100-0007	Technical Requirements for the Supply of Valves
7650-8230-SP-100-0008	Technical Requirements for the Supply of Pipe
7650-8230-SP-100-0009	Technical Requirements for the Supply of Pipe Fittings
7650-8230-SP-100-0010	Technical Requirements for the Supply of Flanges, Fig 8 Blinds, Blanks and Spacers
7650-8230-SP-100-0011	Technical Requirements for the Supply of Gaskets
7650-8230-SP-100-0012	Technical Requirements for the Supply of Bolting
7650-8230-SP-100-0013	Technical Requirements for the Supply of Pipe Bends
7650-8230-SP-100-0014	Technical Requirements for the Supply of Special Piping (SP) Items
7650-8230-SP-100-0015	Certification, Marking and Colour Coding of Bulk Piping Materials
7650-8230-SP-100-0017	Technical Requirements for the Supply of Utility Hose and Couplings
7650-8230-SP-100-0019	Technical Requirements for the Supply of Bulk Y & T Type Strainers
7650-8230-SP-100-0020	Technical Requirements for the Supply of Bulk Steam Traps
7650-8230-SP-100-0021	Technical Requirements Specification for HDPE
7650-8230-SP-100-0022	Technical Requirement for the Supply of GRE- Pipe, Pipe Fittings and Flanges
7650-8230-SP-100-0024	Metallic Piping Components NPS 50" and Greater - Guidelines
7650-8230-SP-100-0025	Underground Piping



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Document No.	Title
7650-8230-DS-100-0002	Particular Material Appraisals (PMAs) in accordance with the Pressure Equipment Directive (PED) 2014/68/EU
7650-8820-IN-100-0002	Standards Index
7650-8820-PR-100-0004	Equipment Numbering Procedure
7650-8820-PR-100-0005	CE Marking Strategy
7650-8440-SP-100-0001	Insulation for Piping and Equipment
7650-8440-SP-100-0002	Protective Paint and Coatings
7650-8440-SP-100-0008	Positive Material Identification (PMI)
7650-8440-SP-100-0010	Pressure Testing of Piping and Equipment
7650-8440-SP-100-0011	General Requirements for Pipework Fabrication
7650-8440-SP-100-0012	Controlled Bolt Tightening
7650-8550-SP-100-0016	Instrument Tubing and Fittings
7650-8440-SP-100-0019	Service Definitions and General Requirements
7650-8440-SP-100-0007	General Requirements for Welded Fabrications

## 5. GENERAL NOTES

Piping material classes for process piping shall be developed according to ASME B31.3 and shall be suitable for use with Normal Fluid Service, Elevated Temperature Fluid Service and Category D Fluid Service. Lines classified as Category M fluid service, based on the definition given in 7650-8440-SP-100-0019, shall require the use of separate dedicated pipe classes. The need for High Pressure Fluid Service and High Purity Fluid Service are not foreseen on the project.

Piping material classes may be developed to an alternate design code if approved by Company.

Piping material classes for power piping shall be developed according to ASME B31.1. Contractor is advised that pipe classes and associated technical specifications to ASME B31.1 will not be developed by IPMT. IPMT project requirements shall remain applicable, however, where these require supplementary requirements for the use of ASME B31.1 (such as material requirements, fabrication, test, and inspection requirements) the Contractor is advised to develop and submit these specifications for Company review and approval. Contractor piping material classes and specifications may then be adopted by IPMT to implement in Project One specifications.

Deviations from this Specification shall be submitted in writing for approval by the IPMT.

The symbols used for identification of piping class designations shall be those indicated in Section 6.0.

### 5.1 PRESSURE EQUIPMENT DIRECTIVE

Project One is subject to the Pressure Equipment Directive and corresponding Royal Decrees (KB) which are a 1:1 translation of the EU Directive.

- Pressure Equipment Directive (PED) (2014/68/EU – KB 11.07.2016)

Particular Material Appraisals as required for the materials referenced in the Piping Material Class Index, will be developed by the IPMT.

### 5.2 SERVICE LIMITS AND PIPE WALL THICKNESS

All pipe wall thicknesses specified in individual pipe classes shall be suitable for the full range of pressure/temperature combinations tabulated. Where calculated wall thickness is specified, this will be based on individual line design conditions as stated on the "Line Classification List".

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The Contractor shall remain responsible for material selection, including corrosion allowance and valve trim, will be suitable for the service, in accordance with the Project requirements. Where the Pipe Materials Class Index includes Service, these shall be considered as guidance, with the responsibility of material selection to remain with the Contractor.

Pipe wall thickness shall be calculated in accordance with the requirements of the Design Code referred to in the service index below.

The minimum wall thickness after reduction by:

- a) Corrosion Allowance
- b) Mill Tolerance
- c) Threading Allowance, where applicable, in accordance with ASME B1.20.1 (NPT).

But shall not be less than the following:

NOM PIPE SIZE	MINIMUM CORRODED THICKNESS (Retirement Thickness)
NPS ½" – NPS ¾"	0.04" (1.0mm)
NPS 1" – NPS 8"	0.06" (1.5mm)
NPS 10"	0.09" (2.3mm)
NPS 12" – NPS 14"	0.110" (2.8mm)
NPS 16" -NPS 24"	0.120" (3.1mm)
NPS 26" – NPS 36"	0.15" (3.8mm)
NPS 38" – NPS 46"	0.18" (4.6mm)
NPS 48"	0.21" (5.3mm)
Above NPS >48"	0.25" (6.4mm)

If the metal thickness required to contain the pressure is less than the "Minimum Corroded Thickness", the "Minimum Corroded Thickness" shall be used. For larger pipe sizes, the minimum thickness may need to be increased to retain the required shape.

For pipe classes with corrosion allowance > 3mm pipe wall thicknesses for NPS ½" through less than NPS 2" have been calculated considering 3mm corrosion allowance.

Wall thickness calculations do not include allowance for wall thickness thinning due to pulled bends.

### 5.3 PRESSURE

All pressures given in this specification are gauge pressure, unless otherwise clearly stated.

All pressures given in this specification are design, unless otherwise clearly stated.

### 5.4 TEMPERATURE

All temperatures given in this specification are design, unless otherwise clearly stated.

### 5.5 PIPE SIZES

Reference 7650-8230-SP-100-0001, Piping Standard, for pipe sizes.

For dimensions of very large bore pipe and fittings, reference: 7650-8230-SP-100-0024 - Metallic Piping Components NPS 50" and Greater - Guidelines .

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REV A14**5.6 THREADS CONNECTIONS**

Reference 7650-8230-SP-100-0001, Piping Standard, for threaded connections.

All screwed connections shall have taper threads in accordance with ASME B1.20.1 (NPT), and limited to NPS 1 " or less.

**5.7 THREADS PIPING SYSTEMS**

Reference 7650-8230-SP-100-0001, Piping Standard, for threaded connections.

**5.8 JOINTING OF SMALL BORE PIPES**

Reference 7650-8230-SP-100-0001, Piping Standard, for threaded connections.

**5.9 TUBING**

Tubing and tubing components shall be in accordance with the Instrument Tubing and Fittings Specification, 7650-8550-SP-100-0016. Piping based on tubing (Example class: UOLY) shall be run in cable tray, for use in chemical dosing services. Hydrocarbon services are prohibited to be run in tubing pipe class.

**5.10 BENDS IN SMALL BORE PIPING**

Pulled bends are prohibited, except with prior written permission by the IPMT.

Where permitted, calculation of the wall thickness shall be performed, considering wall thickness thinning. In small bore welded piping less than 2", hot or cold formed bends with a radius of 5D minimum. Pulled bends are prohibited in Sour Service. The maximum permissible ovality after bending is 5% on outside diameter. The maximum permissible thinning on the back of the bend shall be 12.5% of nominal wall thickness.

Pipe fabricator shall provide his Procedure for Bending, for review. The Procedure shall include verification of the final thickness with five sacrificial bends.

**5.11 NON METALLIC PIPING SYSTEMS**

Requirements for non-metallic piping systems will be as per the referenced Specifications, 7650-8230-SP-100-0021 - Technical Requirements Specification for HDPE and 7650-8230-SP-100-0022 - Technical Requirement for the Supply of GRE- Pipe, Pipe Fittings and Flanges.

CPVC piping systems shall be designed and installed in accordance with Manufacturer's instructions.

**5.12 PIPE**

All metallic pipe shall comply with the requirements of 7650-8230-SP-100-0008, "Technical Requirements for Supply of Pipe".

All pipe seam welds shall be 100% radiographed to provide a weld joint efficiency of 1.0.

Factory Hydro testing of large bore (above NPS 48") manufactured pipe shall be closely reviewed to ensure test criteria covers project design requirements.

Consideration shall be given to potential vacuum when calculating pipe.



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The pipe dimensions shall be in accordance with ASME B36.10M and B36.19M for metallic pipe. For non-metallic pipe, refer to the applicable design Standards.

**5.13 PIPE FITTINGS**

All metallic pipe fittings shall comply with the requirements of 7650-8230-SP-100-0009, "Technical Requirements for Supply of Pipe Fittings.

**5.14 FLANGES**

All metallic pipe flanges shall comply with the requirements of 7650-8230-SP-100-0010, "Technical requirements for the Supply of Flanges, Blind and Spades".

Flanges up to and including NPS 24" shall be in accordance with ASME B16.5 latest edition, and flanges NPS 30" & above, shall be in accordance with ASME B16.47, series A unless otherwise stated.

Care shall be exercised where mating to, or replacing, existing installations. In these cases, the Flange standard and rating shall be ascertained from Site supplied data.

Flanges over NPS 60" shall be in accordance with ASME Section VIII Div.1 – Boiler and Pressure Vessel Code. Refer to 7650-8230-SP-100-0024, Large Bore Metallic Piping Components Guidelines.

Use of slip-on flanges is prohibited.

Flange facing finish shall be per ASME B16.5 unless otherwise stated.

Ring joint flanges shall be used in classes rated CL900 and above unless otherwise stated.

Unless specified in individual pipe classes, flat faced flanges shall only be used when mating to cast iron or non-metallic flanges or to flat face flanges on equipment.

Flanges in Hydrogen Service have additional requirements stated in Section 6.5.

To avoid surface damage during flange tightening and consequent flange leakage during operation, hardness of ring joint flanges and octagonal gaskets shall be controlled. For both materials, it shall be verified that there are different hardness values enough to avoid damage (i.e. hardness of the flange facing is higher than the hardness of the octagonal gasket). Additionally, it is recommended that both surfaces (i.e. flange facing and ring gasket) are visibly marked with their respective hardness values to allow appropriate control during Construction stage.

**5.15 GASKETS**

All gaskets shall comply with the requirements of 7650-8230-SP-100-0011, "Technical requirements for the Supply of Gaskets".

RTJ gaskets, when specified shall comply with ASME B16.20, except where noted otherwise.

"Flexible Graphite" compounds shall contain min. 95% pure Carbon grade, except where specific Service requirement is determined otherwise.

For design temperature above 480 °C suitable gasket filler material such as Thermiculite 835 or equivalent (for spiral wound gasket) and Thermiculite 815 or equivalent (for SS tanged insert gasket) shall be used.

Asbestos in any form is prohibited.

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#### 5.16 BOLTING

The term “Bolting” shall include both stud bolts and hexagonal head type fasteners.

All bolting shall comply with the requirements of 7650-8230-SP-100-0012, “Technical requirements for the Supply of Bolting”.

All bolting shall comply with the requirements of the relevant listed standards and documents.

Bolting Requirements for pipe classes shall generally be as follows:

Temperature	Class Rating	Bolt Material	Nut Material
-50°C to -21°C (2)	Any	ASTM A320 Gr. L7	ASTM A194 Gr.7
-20°C to 420°C	Any	ASTM A193 Gr. B7	ASTM A194 Gr. 2H
>420°C to 593°C (3)	Any	ASTM A193 Gr. B16	ASTM A194 Gr.7
>593°C to 815°C (4)	≤ 300# (1)	ASTM A193Gr.B8M Class 1 (Min. Carbon content ≥ 0.04%)	ASTM A194 Gr.8M
-196 °C to -50°C (5)	Any	ASTM A320 Gr.B8M Class 2, S1 - Bolt diameter ≤ 1 ½” ASTM A193 Gr. B8M2 Class 2B, S2 - Bolt diameter > 1 ½”	ASTM A194 Gr.8M, S59 ASTM A194 Gr.8M, S59
-50 °C to -21°C (6)	Any	ASTM A320 Gr.L7M	ASTM A194 Gr.7M
-20 °C to 400°C (7)	Any	ASTM A193 Gr.B7M	ASTM A194 Gr. 2HM
-20 °C to 70°C (8)	150# only	ASTM A307 Gr. B	ASTM A563 Gr. A

- (1) Class 1 (low yield) bolts shall not be used for flanged joints higher than class 300 rating nor for flanged joints using metallic gaskets unless supported by appropriate design calculations per ASME B31.3, Par. 309.2.1. For Class 600 and above, bolt material shall be proposed and submitted for approval by CONTRACTOR and IPMT.
- (2) Maximum allowable pipe class temperature for bolt & nut configuration is 400 °C.
- (3) Minimum allowable pipe class temperature for bolt & nut configuration is -20 °C. (with impact test).
- (4) Minimum allowable pipe class temperature for bolt & nut configuration is -20 °C.
- (5) Maximum allowable pipe class temperature for bolt & nut configuration is 300 °C.
- (6) Use only in sour service and maximum allowable pipe class temperature for bolt / nut configuration is 300 °C only use in sour service.
- (7) Use only in sour service.
- (8) Bolt configuration shall be used on Non metallic and ductile iron flange connections only.

##### 5.16.1 Bolt Tensioner

All flanged joints employing controlled tensioning, shall comply with requirements of 7650-8440-SP-100-0012 “Controlled Bolt Tightening”.

Unless otherwise stated, hydraulic bolt torquing shall be used for larger bolts. For critical applications where hydraulic tensioners are required, the bolt length shall be increased in line with the recommendations of the manufacturer of the bolt tensioning equipment – generally normal required length plus one bolt diameter.

#### 5.17 FABRICATION

Fabrication of piping shall comply with the Project Standards. Refer to 7650-8440-SP-100-0011 “General Requirements for Pipework Fabrication”, and 7650-8440-SP-100-0007 “General Requirements for Welded Fabrications”.



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The Piping Specification defines the general requirements for PWHT, which has been identified and is applicable to both component manufacture & site fabrication.

PWHT requirements shall be in accordance with the reference in each Pipe Class, project specification & applicable codes and standards or service conditions.

Carbon steel piping which is specified with PWHT as “ASME B31.3” shall have PWHT of all weld joints as per the requirements of this code as well as the additional requirements of project specifications 7650-8440-SP-100-0007 and 7650-8440-SP-100-0011.

Heat treatment which is required to be carried out by the product supplier during manufacture or repair for the following services, shall be stated in the relevant Technical Requirement Specification.:

- All caustic soda solutions, including caustic carryover.
- All amine solutions (service not currently identified).
- All material in wet H<sub>2</sub>S / sour service (service not currently identified).
- Hydrogen service as specified in 7650-8440-SP-100-0019 “Service Definitions and General Requirements”

#### 5.17.1 Charpy Impact testing

Materials shall be impact tested per the following:

ASME B&PVC Section IX P no.	Material	Maximum Testing Temperature	Acceptance criteria (minimum average / single value)
P1	Carbon Steel (excluding LTCS)	-20 °C	27J/ 20J
P1 LTCS	LTCS	-50 °C	
P4	1.25Cr-0.5Mo	-20°C	
P5A	2.25Cr-1Mo	-20°C	
P15E	9Cr-1Mo-V	0°C	
P8, except H grades	Austenitic Stainless Steel, except H grades	-196°C	27J/ 20J and 0.38mm lateral expansion
P8, H grades only	Austenitic Stainless Steel, H grades only	-50°C	
P41 through to P45	Hastelloy B2, Alloy 20	-20°C	27J/ 20J

#### 5.17.2 Positive Material Identification

Positive Material Identification (PMI) shall be carried out on all pressure retaining alloy material components, flange bolting, welds and welding overlays to ensure that nominal composition of the alloy have been correctly supplied and installed, as defined by 7650-8440-SP-100-0008, Positive Material Identification (PMI).

### 5.18 BRANCH REINFORCEMENT

Branch reinforcement shall be in accordance with details in the individual pipe classes.

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#### 5.19 STANDARD SUB ASSEMBLIES

For Hook up assembly ID / pipe class Matrix refer to Attachment 2.0 of this document.

Vent, drain & instrument connections standard assembly details shall be according to 7650-8230-SP-100-0006, "Standard Assemblies for Vents, Drains and Instrument Connections".

#### 5.20 SPECIAL PIPING ITEMS

SP items are defined as unique items which are generally not interchangeable, require individual tagging and therefore cannot be considered as a bulk piping item. If any of the above criteria cannot be confirmed, then the items shall be included in the relevant pipe class.

All SP items shall comply with the requirements of 7650-8230-SP-100-0014, "Technical requirements for the Supply of SP Items".

All special piping items shall be listed, identified, procured and installed fully in accordance with all relevant process and piping specifications. Installation shall conform to Manufacturer's recommendations.

#### 5.21 BURIED PIPING

All buried carbon steel piping shall be externally protected in accordance with 7650-8440-SP-100-0002 "Protective Paint and Coatings".

For details of buried piping refer to 7650-8230-SP-100-0025.

#### 5.22 VALVES

All valves shall comply with the requirements of 7650-8230-SP-100-0007, "Technical requirements for the Supply of Valves".

Valve selection as represented on the P&IDs will typically be based on 7650-8230-SP-100-0005, Manual Bulk Valve Isolation Selection Philosophy.

Valves shall comply with all referenced international standards, specifications.

Gear operated gate and globe valves shall be used where indicated by size & rating to provide the recommended operational effort. Bevel gear operators are to be used in preference to spur gear operators. Where frequency of operation or high operating torque dictates, valves of other sizes may be equipped with gear operators, and the Valve Data Sheet shall indicate such requirements.

Valve Type	Valve Size / Class With Gear Operator					
	CL.150	CL.300	CL.600	CL.900	CL.1500	CL.2500
Gate	≥NPS 14"	≥NPS 10"	≥NPS 8"	≥NPS 6"	≥NPS 4"	≥NPS 3"
Globe	≥NPS 8"	≥NPS 8"	≥NPS 8"	≥NPS 6"	≥NPS 4"	≥NPS 3"
Ball	ALL	ALL	ALL	ALL	ALL	ALL
Plug	ALL	ALL	ALL	ALL	ALL	ALL
Butterfly	≥NPS 6"	≥NPS 6"	≥NPS 4"	-	-	-

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Valve trim numbers for gate, globe and check valves shall be in accordance with API 600, Table 8. When the required trim is not referenced within this specification then the specific material type and grade description shall be referenced in the valve datasheet.

Where ball valves have been selected, the following shall apply:

- Floating ball valves shall be considered suitable for Class 150 and 300 rating up to and including NPS 6".
- Floating ball valves shall be considered suitable for Class 600 rating up to NPS 4".
- Ball valves 8" NB and larger shall be trunnion mounted ball valve design.
- Trunnion mounted ball valves shall be considered for Class 600 ratings for NPS 6" and above.

Valve gland packing material shall be in accordance with the following table.

Group	Packing Type	Service
'A'	Braided graphite top & bottom rings. Die-formed flexible graphite intermediate rings with corrosion inhibitor (low emission)	Hydrocarbon Liquid & Vapour, Hydrogen, H <sub>2</sub> S/HC/H <sub>2</sub> mixtures, Saturated / Superheated Steam, Condensate, Air, Inert Gas, Water (including brackish).  Caustic, Ammonia, Amines, Organic Solvents.  Temperature range minus 240°C to +732°C (above +450°C valves shall be fitted with extended bonnets)
'B'	PTFE / Compressed synthetic Fibre with oil resistant binder	Potable Water, Chemicals, Acids, Halogens, Oxygen and other strong oxidisers  Temp. Range: Minus 268°C to +204°C

Valve specification will indicate gland packing materials for special service duties not covered by the above table.

Gate, Globe and Check valves in pressure class 900 and above in steam service shall have pressure seal bonnets and covers to minimise bonnet leakage. Welded bonnets are acceptable for sizes lower than NPS 2" for classes 900 & above.

Pressure – temperature rating of flanged and butt weld end valves shall be in accordance with ASME B16.34 except for Ball, Plug and Butterfly valves. For soft seated Ball, butterfly valves and sleeve or lined plug valves the maximum design temperature is limited to 200 °C.

All butt weld end valves shall have extension pieces factory fitted to ensure satisfactory installation at site without possibility of damage.

Extension stems and bonnets for valves in insulated lines shall be supplied factory fitted.

Face to Face / End to End dimension of valves shall be as given in the table below. For valves not covered in ASME B16.10, reference shall be made to manufacturer's standard.



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In reciprocating pump and compressor suction & discharge and similar services, swing type check valves are not permitted. Spring-assisted non-slam piston check (also referred to as nozzle check) valves shall be used in this service and at the discharge in parallel pump or compressor system.

Butterfly valves shall be bi-directional, although they may have a “preferred” direction. Valves shall be installed in the “preferred” direction indicated on the valve.

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Valve	Type	End Connection	Size NPS (DN)	Design & Manufacturing standard	Face to face std.
Gate		Flanged / Butt Welded	< 2"	API 602	ASME B16.10 (Long Pattern >CL300) Note1
			2" – 24"	API 600	
			>24"	ASME B16.34	ASME B16.10 (NPS 26" – 36") (Long Pattern >CL300) Note1 MFRS. STD > 36"
Globe		Flanged / Butt Welded	< 2"	API 602	ASME B16.10 (Long Pattern >CL300) Note1
			2" – 16"	API 623	ASME B16.10 (Long Pattern >CL300) Note1
Check	Lift Check (Ball / Piston)	Flanged / Butt Welded	< 2"	API 602	ASME B16.10 (Long Pattern >CL300) Note1
	Nozzle Type (Axial Flow)	Flanged / Butt Welded	<=24"	ASME B16.34	ASME B16.10 (Long Pattern >CL300) Note1
	Swing	Flanged / Butt Welded	≤ 24"	BS1868	ASME B16.10 (Long Pattern >CL300) Note1
	Dual plate	Double Flanged / Butt Welded	> 24"	API 594	API 594 Table 2
	Dual plate for Category 'D' service	Double Flanged	≤ 24"	API 594	API 594 Table 2, CL150
Ball	Reduced Bore / Full Bore	Flanged	≤ 24"	API 608	ASME B16.10 (Long Pattern)
			> 24"	API 6D / ISO 14313	ASME B16.10 (Long Pattern)
Plug	Regular pattern	Flanged	≤ 12"	API 599	ASME B16.10 (Short Pattern)
	Round port full bore pattern	Flanged	≤ 12"	API 599	ASME B16.10 Round port, full bore ≤ NPS 4"
					MFRS. STD > NPS 4"
Diaphragm		Flanged	<= 6"	BS EN 13397	ASME B16.10 (Long Pattern)



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Valve	Type	End Connection	Size (NPS)	Design & Manufacturing standard	Face to face std.
Butterfly	Double / Triple Offset	Double Flanged	<=8"	API 609, Category B	API 609, Table 3B (Long Pattern)
			10" to 24" CL150		ISO 5752 TABLE 1 Series 13 / API 609 Table 3C (Short Pattern)
			10" to 24" => CL300		ISO 5752 TABLE 1 Series 14 / API 609 Table 3C (Short Pattern)
			> 24" CL150		ISO 5752, Table 1, Series 13 / EN 558 Series 13
			> 24" => CL300		ISO 5752, Table 1, Series 14 / EN 558 Series 14
	Concentric (Note 2)	Double Flanged	<= 8"	API 609, Category A	API 609, Table 3B (Long Pattern)
			10" to 24"		ISO 5752 TABLE 1 Series 13 / API 609 Table 3C (Short Pattern)
			> 24"	AWWA C504	AWWA C504 Short Body
NOTE 1: With exceptions according to Paragraph 4.1.1 of ASME B16.10. NOTE 2: For utility service only.					

6. SPECIFIC SERVICE REQUIREMENTS

6.1 General

Reference 7650-8440-SP-100-0019, Service Definition and General Requirements.  
For piping design and fabrication, these requirements shall be supplemented with the requirements given below.

6.2 Cryogenic Service

All pressure containing components shall be austenitic stainless steel or materials having equivalent impact absorption energy. Base metals, weld metals and HAZ (heat affected zone) shall comply with ASME B31.3, Para 323. Austenitic stainless steel pipe and fittings shall be supplied in the solution annealed condition.  
Welded austenitic SS pipe and fittings, shall be made using welding procedures qualified by Charpy Impact Testing at -196 °C.  
The average absorbed energy of 3 test specimens shall be a minimum of 27 Joules. Only one of the three specimens may have an absorbed energy below 27 Joules, and the absorbed energy of that specimen shall be a minimum of 20 Joules. Lateral expansion shall be a minimum of 0.38mm.

6.3 Cold Service

All carbon steel pipe work components in cold service between -21 °C down to -50°C will be specified as Impact tested materials in accordance with the following:

ASTM A333 Gr. 6	Seamless Carbon steel pipe
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ASTM A671 Gr. CC65, Class 32, S2	Weld seam Carbon Steel pipe
ASTM A420 Grade WPL6	Seamless Carbon Steel Fittings
ASTM A420 Grade WPL6-W	Weld seam Carbon Steel Fittings
ASTM A350 Gr. LF2	Forged Carbon Steel Fittings
ASTM A350 Gr. LF2	Forged Carbon Steel Flanges
ASTM A350 Gr. LF2*	Forged Carbon Steel valve bodies
ASTM A352 Gr. LCB*	Cast CS valve bodies, etc.
ASTM A320 Gr. L7	Flange bolting

\* Valve trim to suit service requirements. See Valve Specification.

**6.3.1** Additional Impact test requirements

Pipe, fittings and flange Suppliers are required to confirm in their quotations that all items offered comply with requirements as stated in the Requisition and its Attachments.

**6.3.2** Valves in Cold Service

Refer to 7650-8230-SP-100-0005 Manual Bulk Valve Selection Specification.

API trim 8 shall not be specified below -20°C.

**6.4** **Sulphuric Acid Service**

Component	Material of Construction
General Piping	Alloy 20 cb-3 + 1.5 mm Corrosion Allowance
Piping for heated acid	Alloy 20 cb-3 + 1.5mm Corrosion Allowance to 70 deg. C max. Higher temperatures by IPMT approval only.
Piping around acid pumps	Alloy 20 cb-3 + 1.5mm Corrosion Allowance

**6.4.1** Valves in Sulphuric Acid Service

NPS 4" & smaller

Body & Trim	Alloy 20 cb-3
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Double block valves shall be considered for critical services where tight shutoff is required. For single block valves, Alloy 20 body and Alloy C-276 trim can be used for hot acid service. Carbon steel body with Alloy C-276 trim can be used for cold acid service.

Note (1) Alloy 20 body and Alloy C-276 trim or Carbon steel body with Alloy C-276 trim shall be used if indicated on P&ID.

**6.5** **Hydrogen Service**

Neither unions nor threaded connections shall be used.

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The minimum connection size for vessels and exchangers shall be a NPS 2" flange.

Thermowells shall have either flanged or butt weld connections.

The minimum connection size to piping shall be a NPS 1" flange. Connections to instruments smaller than a NPS 1" shall be made by a NPS 1" flanged connection at the main line, reducing beyond the first flanged valve. Beyond the first valve, butt weld fittings shall be used. Where a screwed connection is unavoidable, it shall be seal welded.

To minimise chances of leakage through flanged joints in Hydrogen Service, the flange and flanged components in Hydrogen Service shall be specified with rating one grade higher than process design requirement. This shall also apply to flanged connections at equipment nozzles (static / rotary / package), safety valve, control valves and flanged instruments. However, pipe class designation shall remain unchanged and the design for non-flanged components shall be based on pipe class rating / process design requirement of the respective pipe class.

Flange sizes not covered in ASME B16.5/ B16.47 shall be designed for the full flange rating of ASME B16.5 flanges one class higher.

The flanges rating to be used for hydrogen service are as follows:

Pipe Class Rating	Flange Rating
Class 150	Use class 300RF flanges ≤ NPS 60"
Class 300	Use class 600RF flanges ≤ NPS 36" > NPS 36" & ≤ NPS 60" use class 300RF flanges
Class 600	Use class 900RTJ flanges ≤ NPS 36"

EXCEPTIONS: The change in flange rating shall not apply to pipe classes with rating 900 and above.

#### 6.5.1 Valves in Hydrogen Service

Valves in this service shall be stated as such on the relevant Valve Data Sheets.

Small bore valves below NPS 2" shall be bellows sealed and have welded bonnet with full penetration welds.

Valve stems on rising stem valves with deep stuffing boxes shall have an extra smooth finish in the gland packing region of 16 micro inches (16 AARH) or better. The valve stem shall be truly round and parallel.

Valve packing shall be suitable for hydrogen service at the absolute pressure and for the process conditions stated on the Requisition/Data Sheet.

Valve glands shall be leak tested with 1.0 Barg (15 psig) air with the valve in the half open position. The valve gland shall be bubble tight. The test results shall be reported and included with the certification supplied with the valves.

A Helium seat leakage test shall be carried out.

Valve castings shall be subject to the following examinations:

- For moderate temperature service (<260 °C), examination (a) or (b) below.
- For high temperature service (>260 °C), examination (a) or (b) plus examination (c) or (d) below.





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- a) All surfaces of each casting (magnetic material only) shall be examined by the magnetic particle method in accordance with ASTM E 709. Acceptability shall be judged in accordance with MSS SP-53, using reference photographs in ASTM E 125.
- b) All surfaces of each casting shall be examined by the liquid penetrant method in accordance with ASTM E 165. Acceptability of flaws and weld repairs shall be judged in accordance with Table 1 of MSS SP-53, using ASTM E 125 as a reference for surface flaws.
- c) Each casting shall be fully radiographed in accordance with ASTM E 142. Acceptability shall be judged in accordance with the stated acceptance levels in Table 302.3.3D of ASME B31.3.
- d) Each casting shall be fully ultrasonically examined in accordance with ASTM E 114. A casting shall only be accepted if there is no evidence of defect depths exceeding 5% of the wall thickness.

Each valve subjected to examination by radiography shall comply ASME Section VIII, Division I, Appendix 7.

Where radiography is not possible, examination by Helium Mass Spectrometer Test (Probe Technique) shall be carried out in accordance with ASME Section V, Subsection A, Article 10, Appendix V – Subject to approval by Project approval.

The design and geometry of valve internals shall remove crevices and stagnant areas.

Valves shall be internally cleaned and free from moisture and grease.

Valves shall be labelled “SUITABLE FOR HYDROGEN SERVICE”.

## **6.6 Oxygen Service**

Oxygen service not currently anticipated. The Project shall be advised should this service arise.

## **6.7 Steam Service**

Refer to 7650-8230-SP-100-0005, Manual Bulk Isolation Valve Selection Specification.

## **6.8 Vacuum Service**

Where ‘PV’ (Partial vacuum) is referenced in the Pipe Class Index, all pipe wall thicknesses shall be calculated for its maximum vacuum capacity. Full vacuum shall be listed as -1.0 Barg in the Pipe Class. Where a selected pipe schedule is of insufficient thickness for full vacuum, the calculated vacuum capacity shall be listed between 0 and -1.0 Barg.

Where the 5th digit of the Pipe Class Number = 4 for vacuum service, the Process shall be protected from contamination due to external ingress by specifying valves with either bellow seal gland arrangement or spring loaded gland arrangement, suitable for full vacuum.

Valves shall be tested for vacuum capability in accordance with ASME Section V, Art.10, Appendix IX (Hood Method).

Stuffing box packing, gaskets and seals shall be suitable for vacuum service at specified temperature.



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**6.9 Sour Service, NACE (Wet H2S Service), HIC**

Services including Sour service, NACE (Wet H2S Service), and HIC not anticipated. The Project shall be advised should any of these criteria arise, and this section will be developed accordingly.

**6.9.1 Hydrogen Induced Cracking (HIC)**

Hydrogen induced cracking service not currently anticipated. The Project shall be advised should this service arise.

**6.9.2 HIC testing**

Hydrogen induced cracking service not currently anticipated. The Project shall be advised should this service arise.

**6.9.3 Material Certification for HIC Service**

Hydrogen induced cracking service not currently anticipated. The Project shall be advised should this service arise.

**6.9.4 Valves in NACE Service**

NACE service not currently anticipated. The Project shall be advised should this service arise.

**6.10 Underground Service**

Where valves are located below grade, they shall be flanged and generally installed in a pit. For butterfly valves, suitable piping arrangement shall be considered for the removal of valves.

Valves which are direct buried shall be fully wrapped according to project standard 7650-8440-SP-100-0002.

Flange connections which are direct buried shall be fully wrapped according to project standard 7650-8440-SP-100-0002.

**6.11 Butadiene Service**

The use of copper, copper containing alloys, and PTFE materials are restricted in lines classified as being Butadiene Service by project specification 7650-8440-SP-100-0019 section 5.11.

To prevent popcorn polymer formation, consideration shall be given to the recommendations specified by EEPCC (European Ethylene Producers Committee).

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## 7. IDENTIFICATION OF PIPING CLASS DESIGNATIONS

The **first** symbol indicates flange ratings and facings as follows:

### a) Raised Face Flanges:

- A - Class 150
- B - Class 300
- C - Class 400
- D - Class 600
- E - Class 900
- F - Class 1500
- G - Class 2500

### b) Ring Type Joint Flanges:

- H - Class 150
- J - Class 300
- K - Class 400
- L - Class 600
- M - Class 900
- N - Class 1500
- P - Class 2500

### c) Lap Joint Flanges:

- Q - Class 150
- R - Class 300

### d) Flat Face Flanges:

- S - Class 125/150
- T - Class 250/300

### e) Non-flange rated systems:

- U –nom 3000psi. etc.

The **second** symbol indicates corrosion allowance (CA) as follows:

- |   |   |   |         |
|---|---|---|---------|
| 0 | - | Indicates nominal CA (ZERO) or that the corrosion and erosion allowance is included in the nominated wall thickness as indicated in the Pipe Class Notes. |         |
| 1 | - | Indicates CA nominal 1.5mm (1mm & above)  | (1/16") |
| 3 | - | Indicates CA nominal 3.0mm  | (1/8")  |
| 6 | - | Indicates nominal CA 6.0mm  | (1/4")  |

The **third** symbol indicates materials as follows: -

- |   |   |  |
|---|---|--|
| A | - | Plain or semi-Killed Carbon Steel  |
| B | - | Carbon Steel, Stainless Steel and/or Copper Tube (Mixed for steam tracing) |

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- C - Glass Reinforced Plastic (GRE).
- D - 1¼% Cr. ½% Mo.
- E - 2¼% Cr. 1% Mo.
- F - 5% Cr. ½% Mo.
- G - KCS, ASTM A333 Gr.B / A671 Gr.C65. Cl.32. Killed, Fine-grained Carbon Steel Impact Tested (LTCS)
- H - 3½% Ni. (low temp. service)
- J - Types 304 or 304L Stainless Steel
- K - Modified Austenitic Stainless Steels  
(H, LN grades &c., or Special Analysis limits)
- L - Types 316 or 316L Stainless Steel
- M - Types 321 or 347 Stainless Steel
- N - Cast Ductile or Grey Iron Plain or Lined
- P - Carbon Steel, Plastic or Rubber Lined
- Q - Carbon Steel, Cement or Epoxy Lined
- R - Carbon Steel Galvanised
- S - uPVC, ABS, c-PVC - Solvent weld or Screwed system.
- T - PP, PVDF, PE - Butt/Socket Fusion or Screwed system.
- U - Carbon Steel, Cement or Epoxy Lined - external  
Coated and Wrapped for underground.
- V - Titanium/ Titanium alloys
- W - Duplex Stainless steels
- X - Ferritic Stainless steels
- Y - Nickel/ Nickel alloys -  
'Monel','Hastelloy','Inconel','Incolloy', Copper Nickel 'CU-NI' etc.
- Z - Aluminium/ Aluminium alloys.
- 1 - Carbon Steel Refractory Lined
- 2 - Alloy 20
- 3 - UNS N08904 (904L, ASTM B625)
- 4 - Hastelloy B-2
- 5 - Super Duplex Stainless Steel
- 6 - Type 316H SS, Type 316SS with 0.04% min. Carbon
- 7 - Inconel 800HT
- 8 - 9%Cr – 1%Mo
- 9 - Carbon Steel Internally epoxy lined

The **fourth** digit indicates service or limiting factor as follows: -

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- A - Utility - Instrument Air, Plant Air, Nitrogen, carbon dioxide and non-Hydrocarbon Utilities - Except Steam or Water services.
- B - Process - Light Hydrocarbons and General Process
- C - Process - Catalyst - catalyst slurry, fluidised or powdered coke, slurry, and other erosive processes
- D - Utility - Hydrocarbon Utilities e.g. Lube Oil, Seal Oil, glycol etc. Demineralised water
- E - Process - Special Service Valve Trim
- F - Process - Sulphur service, and/ or Jacketed Piping systems.
- G - Utility - Boiler Code ASME B31.1, (Steam, condensate, Boiler Feed Water)
- H - Process - Hydrogen or Hydrogen rich Hydrocarbon mixtures, subject to API 941 service requirements.
- J - Acids (specify by Concentration levels)
- K - Chlorine
- L - Amines
- M - Aqueous Ammonia
- N - Caustic (specify by Concentration levels)
- O - Oxygen
- P - Process - General Process (Non Sour Service) + Non corrosive PWHT to ASME B31.3 for CS or Cr-Mo material
- Q - Process - (Moderate Sour Service), subject to NACE Std. MR-0175, MR 0103, TM-0284 etc., service requirements.
- R - Process - (Severe Sour Service), subject to NACE + HIC Std. PWHT mandatory when CS or Cr-Mo material
- S - Utility - Steam, condensate, Boiler Feed Water.
- T - Utility - Tracing by Steam, or Liquid (e.g. Hot Oil etc.). Use symbol F for jacketed systems.
- U - Utility - Fire Water
- V - Corrosive service other than in symbols J or Q,
- W - Utility - Water Services (Cooling, Potable, etc.)
- X - Process - Category 'M' Fluids as determined by Plant Owners.
- Y - Chemical Dosing
- Z - Cryogenic Service
- 1 - **Utility – Seawater**
- 2 - **Process – Low temperature service to -101°C**



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A **fifth digit** may be added as a sequential number (1, 2, 3 etc.) but is used only to accommodate variations in similar pipe classes e.g. difference in the valve trim, difference in the small-bore piping material, additional service criteria etc.

- 1 -       Underground Water Service - Sanitary water, Oily water Sewer, Accidentally Oil contaminated Sewers
  
- 2 -       Additional alternative to “3” requiring VOC low emission criteria.
  
- 3 -       Requires the addition of Toxic / VOC low emission criteria.
  
- 4 -       Requires the addition of Vacuum criteria and ingress protection (bellow seal valve / live loaded valve packing)
  
- 5 -       Underground Process Service
  
- V -       Vendor Pipe Class (see note below)

**NOTE:** Vendor pipe classes used within Vendor Standard Equipment Packages shall be renamed according to the above naming system, except for the 5<sup>th</sup> digit which shall be “V”. It is acceptable for multiple vendor pipe classes to be using the same pipe class name. Vendor packages designed specifically for Project One shall use the pipe classes available in Attachment 1.0.



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**ATTACHMENT 1.0 – PIPING CLASS SERVICE INDEX**



**ATTACHMENT 1.0**  
**PIPE CLASS SERVICE INDEX**

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REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CODES (NOTE 31)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 13)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MATL.	CONST.N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE
A13	A0JA	AD, AF, AI, AP, AS, ATM, AV, NI, N6, N14, PV, SV	150	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	UTILITY - AIR NITROGEN CARBON DIOXIDE	B31.3	NO	NO	NO	D, NFS	10 (SS316)	2.1	SS ASTM A182 F304/304L	BW, FL	-50 150	19.0 14.2	PV	A	L7 / 7	CNAF	1" - 24" (25 - 600)	BA BFdbi GA GL CH	1, 2, 6, 8, 27, 30
A13	A0JD	OD, OF, OH, CL, OS, SC5, WBF, WDM, WDS	150	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	UTILITY - GLYCOL LUBE OIL DEMIN WATER	B31.3	NO	NO	NO	D, NFS	10 (SS316)	2.1	SS ASTM A182 F304/304L	BW, FL	-50 210	19.0 13.0	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA BFipl GA GL CH	1, 6, 8, 9, 27
A13	A0JM	CNH(x)	150	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	UTILITY - AQUEOUS AMMONIA	B31.3	NO	NO	NO	D, NFS	10 (SS316)	2.1	SS ASTM A182 F304/304L	BW, FL	-50 210	19.0 13.0	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA BFipl GA GL CH	1, 6, 8, 9, 27
A13	A0JW	WDK	150	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	UTILITY - ABOVEGROUND POTABLE WATER DRINKING WATER SERVICE WATER (OUTSIDE BUILDINGS ONLY) (NOTE 33)	B31.3	NO	NO	NO	D, NFS	10 (SS316)	2.1	SS ASTM A182 F304/304L	BW, FL	-50 70	10.0 10.0	PV	B	L7 / 7	FOOD GRADE EPDM	1" - 8" (25 - 200)	BA BFbbl GA GL CH	1, 2, 5, 6, 8, 9, 27, 33
A13	A0JZ3	CM, FGC, FGD, FGW, FLC, FLD, H80, PCH4, PC2, PC2MN, PC2M4, PC2H6, PC2PL, PC3H6, PC3H8, PC3MN, PC3, PRG, PV	150	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	PROCESS - HYDROCARBONS CRYOGENIC SERVICE TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	NO	D, NFS	12 (SS316 / HF)	2.1	SS ASTM A182 F304/304L	BW, FL	-106 300	19.0 10.2	FV	A	A320 B8M-Class 2, S1 / A194 8M, S59 <=1.5" Bolt Diameter A193 B8M2-Class 2B, S2 / A194 8M, S59 >1.5" Bolt Diameter	316 SS SPW / GRAPHITE	1" - 60" (25 - 1500)	BAeb BFipl + BFeb + BFspl GAeb + GAspl GLEb + GLbs GLsl + GLspl CH	1, 6, 8, 9, 18, 24, 27
A13	A0LD	OD, OF, OH, CL, OS	150	RF	0.0	316/316L	SS ASTM A312 TP316/316L <= 10" >10" ASTM A358 GR.316/316L CL.1	UTILITY - LUBE OIL SEAL OIL	B31.3	NO	NO	NO	D, NFS	10 (SS316)	2.2	SS ASTM A182 F316/316L	BW, FL	-50 200	19.0 13.7	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA BFipl GA GL CH	1, 6, 8, 9, 27
A13	A0LY	CAM, CCS, CF, CIN, CPH, CS	150	RF	0.0	316/316L	SS ASTM A312 TP316/316L <= 10" >10" ASTM A358 GR.316/316L CL.1	PROCESS - CHEMICAL DOSING	B31.3	NO	NO	NO	D, NFS	12 (SS316 / HF)	2.2	SS ASTM A182 F316/316L	BW, FL	-50 210	19.0 13.4	FV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA GA GL CH	1, 6, 8, 9, 27
A13	A04Y	CH	150	RF	0.0	HASTELLOY B2	ASTM B622 UNS N10665, SMLS	HYDROCHLORIC ACID (30%)	B31.3	NO	NO	NO	D, NFS	ALLOY C276	3.7	ASTM B462 UNS N10665	BW, FL	-20 70	20.0 18.8	PV	B	B7 / 2H	C276 SPW / PTFE	1" - 4" (25 - 100)	BA GA GL CH	1, 6, 15, 27
A13	A1AA	AD, AF, AI, AP, AS, AV, ED, EFG, N6, N14	150	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - NITROGEN AIR ATMOS VENT ATMOS DRAIN (NOTE 33)	B31.3	NO	NO	B31.3	D, NFS, ETFS	8 (13CR / HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	19.6 6.5	PV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 90" (25 - 2300)	BFipl GA GL CH	1, 5, 30, 33
A13	A1AH3	GF, H80, H99, PCH4, PRG	150 (Use 300# flange)	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - HYDROGEN OR HYDROGEN RICH HYDROCARBON MIXTURE	B31.3	NO	NO	YES	D, NFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 260	19.6 11.7	FV	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 48" (25 - 1200)	BA BFipl + BFspl GAspl GLbs GLspl CH	1, 5, 18, 21, 27





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PIPE CLASS SERVICE INDEX

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REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CODES (NOTE 31)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 13)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MAT'L	CONST.N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE
A13	A1AP3	CM, CWO, ERE, FGW, FLW, GF, GN, H80, H99, PC2H4, PC2, PC2MN, PC2H4, PC2H6, PC2PL, PC3, PC3MN, PC3PL, PC3H8, PC4, PC4PL, PC5PL, PC3H6, PPO, PRG, PV	150	RF	1.5	CS	CS ASTM A106 Gr B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - NON SOUR NON CORROSIVE HYDROCARBON TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	19.6 6.5	PV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 60" (25 - 1500)	BA BFtpl + BFspl GAspl GLbs GLspl CH	1, 5, 18, 27
A13	A1AP4	CWO, PC3H8, PV	150	RF	1.5	CS	CS ASTM A106 Gr B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - VACUUM SERVICE NON SOUR NON CORROSIVE	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 404	19.6 6.3	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 96" (25 - 2400)	BA BFtpl + BFspl GAspl GLbs GLspl CH	1, 4, 5, 18, 27
A13	A1AS	S3, S5, SP, WBF	150	RF	1.5	CS	CS ASTM A106 Gr B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - LOW PRESSURE STEAM BOILER FEED WATER	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	19.6 6.5	FV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 42" (25 - 1050)	GA GL CH	1, 5
A13	A1AS4	S1, SC1	150	RF	1.5	CS	CS ASTM A106 Gr B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - VACUUM LOW PRESSURE STEAM	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	19.6 6.5	FV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 42" (25 - 1050)	GAspl GLbs GLspl CH	1, 4, 5
A13	A1DH3	GF, H80, H99, PC2H4, PC2MN, PRG	150 (Use 300# flange)	RF	1.5	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24"	PROCESS - HYDROGEN OR HYDROGEN RICH HYDROCARBON MIXTURE - HIGH TEMPERATURE REGEN GAS	B31.3	NO	NO	YES	D, NFS	5 (HF)	1.9	1 1/4 CR-1/2 MO ASTM A182 GR.F11 CL.2	BW, FL	-20 360	19.8 8.0	FV	A	B16 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BFtpl + BFspl GAspl GLbs GLspl CH	1, 5, 18, 21
A13	A1DP	AF, AP	150	RF	1.5	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24" >24" ASTM A691 GR.1 1/4CR CL.42	PROCESS - NON SOUR NON CORROSIVE	B31.3	NO	NO	YES	D, NFS, ETFS	5 (HF)	1.9	1 1/4 Cr-1/2 Mo ASTM A182 GR.F11 CL.2	BW, FL	-20 482	19.8 3.4	PV (MAX 475 DEG C)	A	B16 / 7	316 SS SPW / THERMICULITE 835	1" - 90" (25 - 2300)	GAeb GLEb CH	1, 5, 16
A13	A1GP3	FGD, FLD, GF, GN, PC2H4, PC2, PC2MN, PC2H4, PC2H6, PC2PL, PC3, PC3MN, PC3PL, PC3H8, PC4, PC4PL, PC3H6, PV	150	RF	1.5	LTCS	LTCS ASTM A333 Gr6 >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - NON SOUR LOW TEMPERATURE SERVICE, VOC LOW EMISSION CRITERIA	B31.3	NO	NO	B31.3	D, NFS	12 (SS316 / HF)	1.3	LTCS ASTM A350 GR. LF2	BW, FL	-50 300	18.4 10.2	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 66" (25 - 1650)	BA BFtpl + BFspl GAspl GLbs GLspl CH	1, 5, 17, 18, 27
A13	A12Y	CH	150	RF	1.5	ALLOY 20	ASTM B729 UNS N08020, SMLS	SULPHURIC ACID (98%) SERVICE	B31.3	NO	NO	NO	D, NFS	13 (ALLOY 20)	3.1	ASTM B462 UNS N08020	BW, FL	-20 70	20 18.8	PV	B	B7 / 2H	ALLOY 20 / PTFE	1" - 4" (25 - 100)	BA GA GL CH	1, 6, 15, 27
A13	A3AN3	CCF, CCS, CWO, NB, PC5PL, PRG	150	RF	3.0	CS	CS ASTM A106 Gr B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - CAUSTIC : 20% CONC., 50% CONC. AND >5% BENZENE (STRESS RELIEVED)	B31.3	NO	NO	YES	D, NFS	9 (MONEL)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 210	19.6 13.5	FV	A	B7 / 2H	MONEL SPW / GRAPHITE	1" - 36" (25 - 900)	BA GAspl GLbs GLspl CH	1, 5, 15, 18, 27
A14	A3AP3	FGW, FLW, H80, PC5PL, PPO, PRG, PV, VOC	150	RF	3.0	CS	CS ASTM A106 Gr B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - NON SOUR NON CORROSIVE HYDROCARBON TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	B31.3	D, NFS, ETFS	5(HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 425	19.6 5.5	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 72" (25 - 1800)	BA BFtpl + BFspl GAspl GLbs GLspl CH BAmc (Note 34)	1, 5, 18, 27, 34
A13	A3AP4	PC5PL, PPO, PV	150	RF	3.0	CS	CS ASTM A106 Gr B (impact tested) <=24"	PROCESS - VACUUM SERVICE NON SOUR NON CORROSIVE	B31.3	NO	NO	B31.3	D, NFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 330	19.6 9.1	FV	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 12" (25 - 300)	BA BFtpl + BFspl GAspl GLbs GLspl CH BAmc (Note 34)	1, 4, 5, 18, 27, 34

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## PIPE CLASS SERVICE INDEX

REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CODES (NOTE 31)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 13)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MATL.	CONST.N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE
A13	A3AS	SV, SC1, SC5, WBF	150	RF	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - LOW PRESSURE CONDENSATE BOILER FEED WATER	B31.3	NO	NO	B31.3	D, NfS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	19.6 6.5	FV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 48" (25 - 1200)	GA GL CH	1, 5
A13	A3AU	WF	150	RF	3.0	CS	CS ASTM A106 GR.B (impact tested) <= 24" >24" API 5L GR.B	UTILITY - ABOVEGROUND WATER SERVICE FIREWATER  (FIREWATER - Buried / Underground - See note 32)	B31.3	NO	NO	B31.3	D, NfS	8 (13CR/HF)	1.1	LTCS ASTM A350 GR. LF2	SW, BW, FL	-20 70	16.0	PV	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 30" (25 - 750)	GA GL CH	1, 5, 32
A13	A3AV	OCC, DO, DOC, WOR, WCR, WP, WW	150	RF	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - CORROSIVE  UTILITY - ABOVEGROUND CONTAMINATED WASHWATER	B31.3	NO	NO	B31.3	D, NfS, ETFS	12 (SS316 / HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 420	19.6 5.7	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 68" (25 - 1700)	BA BFpl GA GL CH	1, 5, 27
A13	A3AW	WCCS, WCCR, WCI, WCR, WCS, WS	150	RF / FF	3.0	CS	CS ASTM A106 GR.B (impact tested) <= 24" >24" API 5L GR.B	UTILITY - ABOVEGROUND WATER SERVICE SERVICE WATER COOLING WATER	B31.3	NO	NO	B31.3	D, NfS	8 (13CR / HF)  EPOXY LINED, AL BRONZE DISC / BUNA-N SEAT	1.1	LTCS ASTM A350 GR. LF2	SW, BW, FL	-20 70	10.0	PV	A<24" B>24"	B7 / 2H	SYN. FIBRE / OIL RESISTANT BINDER	1" - 72" (25 - 1800)	BFdbt GA GL CH	1, 2, 5
A13	A3GP3	PRG, FGW, FLW	150	RF	3.0	LTCS	LTCS ASTM A333 Gr6 >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - LOW TEMPERATURE SERVICE, VOC LOW EMISSION CRITERIA FLARE	B31.3	NO	NO	B31.3	D, NfS	12 (SS316 / HF)	1.3	LTCS ASTM A350 GR. LF2	BW, FL	-50 300	18.4 10.2	FV (MAX 125 DEG C)	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 56" (25 - 1400)	BA BFpl + BFspl GA GLbs GLspl CH	1, 5, 17, 18, 27
A13	A6AC	AD, ED	150	RF	6.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - CATALYST - CATALYST SLURRY, FLUIDISED OR POWDERED COKE, DECOKE EFFLUENT, SLURRY, AND OTHER EROSION PROCESSES	B31.3	NO	NO	B31.3	D, NfS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	4.0	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE (NOTE 28)	1" - 30" (25 - 750)	BAmc CH	1, 5
A13	A6AV	WW	150	RF	6.0	CS	CS ASTM A106 GR.B (impact tested) <= 24"	PROCESS - CORROSIVE  UTILITY - ABOVEGROUND CONTAMINATED WASHWATER SLUDGE	B31.3	NO	NO	B31.3	D, NfS	16 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 100	19.6 17.7	PV	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 6" (25 - 150)	BAmc	1, 5
A13	B0JA	AF, AP, AS, N14, N28	300	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	UTILITY - AIR NITROGEN CARBON DIOXIDE	B31.3	NO	NO	NO	D, NfS	10 (SS316)	2.1	SS ASTM A182 F304/304L	BW, FL	-50 150	49.6 37.0	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA BFdbt GA GL CH	1, 2, 6, 8, 9, 27, 30
A13	B0JD	OD, OF, OH, OL, OS	300	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	UTILITY - GLYCOL LUBE OIL	B31.3	NO	NO	NO	D, NfS	10 (SS316)	2.1	SS ASTM A182 F304/304L	BW, FL	-50 150	49.6 37.0	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA BFpl GA GL CH	1, 6, 8, 9, 27
A13	B0JP3	FGC, FGD, FLC, FLD, H99, PC3H6	300	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	PROCESS - GENERAL CORROSIVE SERVICE	B31.3	NO	NO	NO	D, NfS	12 (SS316 / HF)	2.1	SS ASTM A182 F304/304L	BW, FL	-50 300	49.6 30.9	FV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 36" (25 - 900)	BA BFpl + BFspl GA GLbs GLspl CH	1, 6, 8, 27
A13	B0JZ3	FGC, FGD, FLC, FLD, H80, PC4H, PC2, PC3MN, PC2H4, PC2H6, PC3PL, PC3H6, PC3MN, PC3PL, PRG	300	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	PROCESS - HYDROCARBONS CRYOGENIC SERVICE TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	NO	D, NfS	12 (SS316 / HF)	2.1	SS ASTM A182 F304/304L	BW, FL	-196 300	49.6 30.9	FV	A	A320 B8M-Class 2, S1 / A194 2M, S59 <=1.5" Bolt Diameter A193 B8M2-Class 2B, S2 / A194 2M, S59 >1.5" Bolt Diameter	316 SS SPW / GRAPHITE	1" - 48" (25 - 1200)	BAeb BFpl + BFeb + BFspl GAeb + GASpl GLEb + GLbs GLEb + GLspl CH	1, 6, 8, 9, 18, 24, 27
A13	B0LY	CAM, CIN, CPH, CS	300	RF	0.0	316/316L	SS ASTM A312 TP316/316L <= 10" >10" ASTM A358 GR.316/316L CL.1	PROCESS - CHEMICAL DOSING	B31.3	NO	NO	NO	D, NfS	12 (SS316 / HF)	2.2	SS ASTM A182 F316/316L	BW, FL	-50 350	49.6 30.3	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA GA GL CH	1, 6, 8, 9, 27
A13	B0MH3	ERE, H80, H99, PC4	300 (Use 600# flange)	RF	0.0	321H	SS ASTM A312 TP321H <=10" >10" ASTM A358 GR.321H CL.1, S5 (SHT @ 1093 °C)	PROCESS - HYDROGEN OR HYDROGEN RICH HYDROCARBON MIXTURE - HIGH TEMPERATURE	B31.3	NO	NO	NO	D, NfS	17 (SS347 / Full Hard Faced)	2.4	SS ASTM A182 F321H	BW, FL	-50 500	49.6 28.2	FV (MAX 375 DEG C)	A	B16 / 7	316 SS SPW / THERMICULITE 835	1" - 10" (25 - 250)	GAspl + GAeb GLbs + GLEb GLspl + GLEb CH	1, 6, 7, 18

**ATTACHMENT 1.0****PIPE CLASS SERVICE INDEX**

REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CODES (NOTE 31)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 13)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MAT'L	CONST.N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE
A13	B1AA	AP, N6, N14, N28	300	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - NITROGEN AIR	B31.3	NO	NO	B31.3	D, NFS, ETFS	8 (13CR / HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 420	51.10 30.0	PV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 30" (25 - 750)	BA BFpl GA GL CH	1, 5, 27, 30
A13	B1AH3	GF, H80, H99, PCH4, PC2MN, PRG	300 (Use 600W flange)	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - HYDROGEN OR HYDROGEN RICH HYDROCARBON MIXTURE	B31.3	NO	NO	YES	D, NFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 260	51.1 41.5	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 48" (25 - 1200)	BA BFpl + BFspl GAspl GLbs GLspl CH	1, 5, 18, 21, 27
A13	B1AP3	CM, CWO, GF, GN, H80, H99, PCH4, PC2, PC2MN, PC2H4, PC2H6, PC2PL, PC3, PC3MN, PC3PL, PC3H6, PC4, PC4PL, PC5PL, PRG, PC3, PC3H6, PRG	300	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - NON SOUR NON CORROSIVE HYDROCARBON TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	51.1 34.7	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 30" (25 - 750)	BA BFpl + BFspl GAspl GLbs GLspl CH	1, 5, 18, 27
A13	B1AS	S5, S18, SC18, SP, WBF	300	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - MEDIUM PRESSURE STEAM	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 420	51.1 30.0	FV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 48" (25 - 1200)	GA GL CH	1, 5
A13	B1DH2	ERE, GF, H89, H99, PCH4, PC2MN, PRG	300 (Use 600W flange)	RF	1.5	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24" >24" ASTM A691 GR.1 1/4CR CL.42	PROCESS - HYDROGEN OR HYDROGEN RICH HYDROCARBON MIXTURE - HIGH TEMPERATURE	B31.3	NO	NO	YES	D, NFS, ETFS	5 (HF)	1.9	1 1/4 CR-1/2 MO ASTM A182 GR.F11 CL.2	BW, FL	-20 505	51.7 24.2	FV (MAX 395 DEG C)	A	B16 / 7	316 SS SPW / THERMICULITE 835	1" - 12" (25 - 300)	GAspl + GAeb GLbs + GLeb GLspl + GLeb CH	1, 5, 18, 21
A13	B1DH3	GF, H80, H99, PCH4, PC2MN, PRG	300 (Use 600W flange)	RF	1.5	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24" >24" ASTM A691 GR.1 1/4CR CL.42	PROCESS - HYDROGEN OR HYDROGEN RICH HYDROCARBON MIXTURE - HIGH TEMPERATURE	B31.3	NO	NO	YES	D, NFS	5 (HF)	1.9	1 1/4 CR-1/2 MO ASTM A182 GR.F11 CL.2	BW, FL	-20 395	51.7 36.9	FV	A	B16 / 7	316 SS SPW / GRAPHITE	1" - 30" (25 - 750)	BFspl + BFspl GAspl GLbs GLspl CH	1, 5, 18, 21
A13	B1DP3	PC4, EFG	300	RF	1.5	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24"	PROCESS - NON SOUR NON CORROSIVE HYDROCARBON TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	YES	D, NFS, ETFS	5 (HF)	1.9	1 1/4 CR-1/2 MO ASTM A182 GR.F11 CL.2	BW, FL	-20 525	51.7 18.5	PV (MAX 395 DEG C)	A	B16 / 7	316 SS SPW / THERMICULITE 835	1" - 24" (25 - 600)	GAspl + GAeb GLbs + GLeb GLspl + GLeb CH	1, 5, 18
A13	B1GH3	PC3, GF, H89, H99, PC2MN, PC3H6	300 (Use 600W flange)	RF	1.5	LTCS	LTCS ASTM A333 Gr6	PROCESS - HYDROGEN OR HYDROGEN RICH HYDROCARBON MIXTURE	B31.3	NO	NO	YES	D, NFS	12 (SS316 / HF)	1.3	LTCS ASTM A350 GR. LF2	BW, FL	-50 275	48.0 39.7 (NOTE 21)	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 14" (25 - 350)	BA BFpl + BFspl GAspl GLbs GLspl CH	1, 5, 17, 18, 21, 27
A13	B1GP3	CHN, PCH4, PC2, PC2MN, PC2H4, PC2H6, PC2PL, PC3, PC3MN, PC3PL, PC3H6, PC4, PC4PL, PC3H6, PC5PL, PV	300	RF	1.5	LTCS	LTCS ASTM A333 Gr6 >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - LOW TEMPERATURE SERVICE VOC LOW EMISSION CRITERIA	B31.3	NO	NO	B31.3	D, NFS, ETFS	12 (SS316 / HF)	1.3	LTCS ASTM A350 GR. LF2	BW, FL	-50 400	48.0 32.6	PV (MAX 375 DEG C)	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 48" (25 - 1200)	BA BFpl + BFspl GAspl GLbs GLspl CH	1, 5, 17, 18, 27
A13	B3AN3	CCF, CCS	300	RF	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - CAUSTIC : 20% CONC., 50% CONC. AND >5% BENZENE (STRESS RELIEVED)	B31.3	NO	NO	YES	D, NFS	9 (MONEL)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 210	51.1 43.4	FV	A	B7 / 2H	MONEL SPW / GRAPHITE	1" - 24" (25 - 600)	BA GAspl GLbs GLspl CH	1, 5, 15, 27

## ATTACHMENT 1.0

## PIPE CLASS SERVICE INDEX

REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CODES (NOTE 31)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 13)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MAT'L	CONST,N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE		
A13	B3AP3	CM, CWO, FLW, GF, GN, PCH4, PC2, PC2MN, PC2H4, PC2H6, PC2PL, PC3, PC3MN, PC3PL, PC3H8, PC4, PC4PL, PC5PL, PPO, PC3, PC3H6	300	RF	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - NON SOUR NON CORROSIVE HYDROCARBON TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)		1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	51.1 34.7	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 36" (25 - 900)	BFpl + BFspl GAspl GLbs GLspl CH BAmc (Note 34)	1, 5, 18, 34	
A13	B3AP4	PC5PL, PPO, PV	300	RF	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - VACUUM SERVICE NON SOUR NON CORROSIVE	B31.3	NO	NO	B31.3	D, NFS	5 (HF)		1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 330	51.1 38.4	FV	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA BFpl + BFspl GAspl GLbs GLspl CH	1, 4, 5, 18, 27	
A14	B3AS	WBF, SC5, SC16, SP, SV	300	RF	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - MEDIUM PRESSURE CONDENSATE BOILER FEED WATER	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)		1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	51.1 34.7	FV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 48" (25 - 1200)	GA GL CH	1, 5	
A13	B3AV	WP, WW, WCR, WCS	300	RF	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - CORROSIVE WASTE WATER BLOWDOWN COOLING WATER	B31.3	NO	NO	B31.3	D, NFS, ETFS	12 (SS316 / HF)		1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	51.10 34.7	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 30" (25 - 750)	BA BFpl GA GL CH	1, 5, 27	
A13	B3AW	WDCS, WCCR, WCI, WCR, WCS	300	RF	3.0	CS	CS ASTM A106 GR.B (impact tested) <= 24" >24" API 5L GR.B	UTILITY - ABOVEGROUND WATER SERVICE SERVICE WATER COOLING WATER	B31.3	NO	NO	B31.3	D, NFS	8 (13CR / HF) RUBBER LINED EPOXY LINED		1.1	LTCS ASTM A350 GR. LF2	SW, BW, FL	-20 70	33.0 33.0	PV	A	B7 / 2H	SYN. FIBRE / OIL RESISTANT BINDER	1" - 24" (25 - 600)	BFdbl GA GL CH	1, 2, 5	
A14	B3DS	ERE, SV	300	RF	3.0	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24" >24" ASTM A691 GR.1 1/4CR CL.42	UTILITY - STEAM VENT	B31.3	NO	NO	YES	D, NFS, ETFS	5(HF)		1.9	1 1/4 CR-1/2 MO ASTM A182 GR.F11 CL.2	BW, FL	-20 540	51.7 14.5	FV (MAX 160 DEG C)	A	B16 / 7	316 SS SPW / THERMICULITE 835	1" - 30" (25 - 750)	GA GL CH	1, 5	
A13	B3MP3	PRG	300	RF	3.0	321H	SS ASTM A312 TP321H <=10" >10" ASTM A358 GR.321H CL.1, S5 (SHT @ 1093 °C)	PROCESS - HIGH TEMP. SERVICE CRACKED GAS OR STEAM DECOKE AIR	B31.3	NO	NO	NO	D, NFS, ETFS	17 (SS347 / Full Hard Faced)		2.4	SS ASTM A182 F321H	BW, FL	-20 580	3.9 3.9	FV (MAX 375 DEG C)	A	B16 / 7	316 SS SPW / THERMICULITE 835	1" - 36" (25 - 900)	GAbs + GAeb GAspl + GAeb GLbs + GLeb GLspl + Gleb CH	1, 6, 7, 18	
A13	D0JZ3	FGC, FGD, FLC, FLD, H80, PCH4, PC2, PC2MN, PC2H4, PC2H6, PC2PL, PC3MN	600	RF	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	PROCESS - HYDROCARBONS CRYOGENIC SERVICE TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	NO	D, NFS	12 (SS316 / HF)		2.1	SS ASTM A182 F304/304L	BW, FL	-196 65 250 300	62.1 67.2 40.7 38.6	FV	A		A320 B8M-Class 2, S1 / A194 8M, S59 <=1.5" Bolt Diameter A193 B8M2-Class 2B, S2 / A194 8M, S59 >1.5" Bolt Diameter	316SS SPW / GRAPHITE	1" - 24" (25 - 600)	BAeb Btpl + BFeb + BFspl GAeb + GAspl GLEb + GLbs GLspl + GLspl CH	1, 6, 8, 9, 18, 24, 27
A13	D6LY	CPH	600	RF	0.0	316/316L	SS ASTM A312 TP316/316L <= 10" >10" ASTM A358 GR.316/316L CL.1	PROCESS - CHEMICAL DOSING	B31.3	NO	NO	NO	D, NFS	12 (SS316 / HF)		2.2	SS ASTM A182 F316/316L	BW, FL	-50 200	99.3 71.3	PV	A	L7 / 7	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA GA GL CH	1, 6, 8, 9, 27	
A13	D1AA	N6, N14, N28	600	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY HP NITROGEN	B31.3	NO	NO	B31.3	D, NFS, ETFS	8 (13CR / HF)		1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 420	102.1 59.9	PV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	BA GA GL CH	1, 5, 27	
A13	D1AP3	CM, GF, GN, PCH4, PC2, PC2MN, PC2H4, PC2H6, PC2PL, PC3, PC3MN, PC3PL, PC3H8, PC4, PC4PL, PC5PL, PPO, PC3, PC3H6	600	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - NON SOUR NON CORROSIVE HYDROCARBONS	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)		1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	102.1 69.4	FV (MAX 375 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 30" (25 - 750)	BA BFpl + BFspl GAspl GLbs GLspl CH	1, 5, 18, 27	



**ATTACHMENT 1.0**  
**PIPE CLASS SERVICE INDEX**

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REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CODES (NOTE 3)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 1)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MAT'L	CONST.N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE
A13	D1AS	S41, S42, S46, WBF	600	RF	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - HIGH PRESSURE STEAM BOILER FEED WATER	B31.3	NO	NO	B31.3	D, NfS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 420	102.1 59.9	FV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 36" (25 - 900)	GA GL CH	1, 5
A13	D3AS	SC42, SV, WBF	600	RF	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - HIGH PRESSURE CONDENSATE BOILER FEED WATER	B31.3	NO	NO	B31.3	D, NfS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 420	102.1 59.9	FV (MAX 160 DEG C)	A	B7 / 2H	316 SS SPW / GRAPHITE	1" - 24" (25 - 600)	GA GL CH	1, 5
A13	E0JZ3	PC2H4	900	(RF)	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	PROCESS - HYDROCARBONS CRYOGENIC SERVICE TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	NO	D, NfS	12 (SS316 / HF)	2.1	SS ASTM A182 F304/304L	BW	-196 65	130	FV	A	A320 B8M-Class 2, S1 / A194 8M, S59 <=1.5" Bolt Diameter A193 B8M2-Class 2B, S2 / A194 8M, S59 >1.5" Bolt Diameter	316 SS KAMMPROFILE	1" - 36" (25 - 900)	GAeb + GAspl GLbs + GLbs GLspl + GLspl CH	1, 6, 8, 9, 18, 24, 26
A13	F0JZ3	FGC, FGD, FLD, H80, PCH4, PC2, PC2MN, PC2H4, PC2H6, PC2PL, PC3MN	1500	(RF)	0.0	304/304L	SS ASTM A312 TP304/304L <= 10" >10" ASTM A358 GR.304/304L CL.1	PROCESS - HYDROCARBONS CRYOGENIC SERVICE TOXIC / HAZARDOUS BENZENE / BUTADIENE	B31.3	NO	NO	NO	D, NfS	12 (SS316 / HF)	2.1	SS ASTM A182 F304/304L	BW	-196 65 300	173.6 160.0 106.1	FV	A	A320 B8M-Class 2, S1 / A194 8M, S59 <=1.5" Bolt Diameter A193 B8M2-Class 2B, S2 / A194 8M, S59 >1.5" Bolt Diameter	316SS KAMMPROFILE	1" - 24" (25 - 600)	GAeb + GAspl GLbs + GLbs GLspl + GLspl CH  GAspl GLbs GLspl	1, 6, 8, 9, 18, 24, 26
A13	J3DP4	GF, PC3H8, SS	300	RTJ	3.0	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24" >24" ASTM A691 GR.1 1/4CR CL.42	PROCESS - NON SOUR NON NACE SOUR (HIGH TEMPERATURE SERVICE)	B31.3	NO	NO	YES	D, NfS, ETFS	5 (HF)	1.9	1 1/4 Cr-1/2 Mo ASTM A182 GR.F11 CL.2	BW, FL	-20 510	8.0 8.0	FV (MAX 480)	A	B16 / 7	OCTAGONAL RING: 316 SS	1" - 72" (25 - 1800)	GAspl + GAeb GLbs + GLeb GLspl + GLeb CH	1, 4, 5, 16, 18
A13	J3EP4	PC3	300	RTJ	3.0	2 1/4CR	2 1/4 Cr-1 Mo ASTM A335 GR. P22 <=24" >24" ASTM A691 GR.2 1/4CR CL.42	PROCESS - NON SOUR NON NACE SOUR (HIGH TEMPERATURE SERVICE)	B31.3	NO	NO	YES	D, NfS, ETFS	5 (HF)	1.10	2 1/4 Cr-1 Mo ASTM A182 GR.F22 CL.3	BW, FL	-20 540	8.0	FV (MAX 475 DEG C)	A	B16 / 7	OCTAGONAL RING: 316 SS	1" - 36" (25 - 900)	GAspl + GAeb GLbs + GLeb GLspl + GLeb CH	1, 4, 5, 16, 18
A13	L10S	S42	600	(RTJ)	1.5	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24" >24" ASTM A691 GR.1 1/4CR CL.42	PROCESS - PURGE STEAM HIGH PRESSURE STEAM BOILER FEED WATER	B31.3	NO	NO	YES	D, NfS	5 (HF)	1.9	1 1/4 Cr-1/2 Mo ASTM A182 GR.F11 CL.2	BW	-20 450	75.0 49.0	FV	A	B16 / 7	OCTAGONAL RING: 316 SS	1" - 24" (25 - 600)	GA GL CH	1, 5, 26
A13	M1DS	S4, WBF	900	(RTJ)	1.5	1 1/4CR	1 1/4 Cr-1/2 Mo ASTM A335 GR. P11 <=24" >24" ASTM A691 GR.1 1/4CR CL.42	UTILITY - HIGH PRESSURE STEAM BOILER FEED WATER	B31.3	NO	NO	YES	D, NfS, ETFS	5 (HF)	1.9	1 1/4 Cr-1/2 Mo ASTM A182 GR.F11 CL.2	BW	-20 482	155.1 90	FV (MAX 160 DEG C)	A	B16 / 7	OCTAGONAL RING: 316 SS	1" - 30" (25 - 750)	GAspl + GAsps + GAeb GLbs + GLwb + GLeb GLspl + GLps + GLeb CHps	1, 5, 25, 26
A13	M1GP3	PC2H4, PC3H6	900	RF	1.5	LTCS	LTCS ASTM A333 Gr6 >24" ASTM A671 GR.CC60 CL.32, S2	PROCESS - LOW TEMPERATURE SERVICE VOC LOW EMISSION CRITERIA	B31.3	NO	NO	B31.3	D, NfS, ETFS	12 (SS316 / HF)	1.3	LTCS ASTM A350 GR. LF2	BW, FL	-50 400	144.1 97.9	PV (MAX 375 DEG C)	A	L7 / 7	316 SS KAMMPROFILE	1" - 24" (25 - 600)	GAspl GLbs GLspl CH	1, 5, 17, 18
A13	M1GP5	PC2H4, PC3H6	900	(RF)	1.5	LTCS	LTCS ASTM A333 Gr6	PROCESS - UNDERGROUND LOW TEMPERATURE SERVICE VOC LOW EMISSION CRITERIA	B31.3	NO	NO	B31.3	D, NfS, ETFS	N/A	1.3	LTCS ASTM A350 GR. LF2	BW	-50 400	144.1 97.9	-	A	L7 / 7	316 SS KAMMPROFILE	1" - 24" (25 - 600)	N/A	1, 5, 12, 17, 26
A13	M3AS	SC42, WBF	900	RTJ	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - CONDENSATE, BOILER FEED WATER	B31.3	NO	NO	B31.3	D, NfS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	153.2 104.2	FV (MAX 160 DEG C)	A	B7 / 2H	OCTAGONAL RING: SOFT IRON	1" - 24" (25 - 600)	GA GL CH	1, 5



**ATTACHMENT 1.0**  
**PIPE CLASS SERVICE INDEX**

PIPING MATERIALS CLASS SERVICE INDEX  
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REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CODES (NOTE 31)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 13)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MAT'L	CONST.N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE
A13	N0LD	OH	1500	RTJ	0.0	316/316L	SS ASTM A312 TP316/316L <= 10" >10" ASTM A358 GR.316/316L CL.1	UTILITY - GLYCOL LUBE OIL	B31.3	NO	NO	NO	D, NFS	10 (SS316)	2.2	SS ASTM A182 F316/316L	BW, FL	-50 300	248.2 158.1	PV	A	L7 / 7	OCTAGONAL RING: 316 SS	1" - 4" (25 - 100)	GA GL CH	1, 6, 8, 9
A13	N0LY	CPH	1500	RTJ	0.0	316/316L	SS ASTM A312 TP316/316L <= 10" >10" ASTM A358 GR.316/316L CL.1	PROCESS - CHEMICAL DOSING	B31.3	NO	NO	NO	D, NFS	12 (SS316 / HF)	2.2	SS ASTM A182 F316/316L	BW, FL	-50 200	248.2 178.3	PV	A	L7 / 7	OCTAGONAL RING: 316 SS	1" - 4" (25 - 100)	GA GL CH	1, 6, 8, 9
A12	N1AG	S120, WBF, S110, WP	1500	(RTJ)	1.5	CS	CS ASME SA-106 Gr.B (impact tested) <=24" >24" ASME SA-671 GR.CC60 CL.32, S2	UTILITY - BOILER CODE ASME B31.1 BLOWDOWN SATURATED HIGH PRESSURE STEAM BOILER FEED WATER	B31.1	NO	NO	B31.1		5 (HF)	1.1	LTCS ASME SA-350 GR. LF2	BW	-20 160 340	255.3 224 139	FV (MAX 160 DEG C)	A	B7 / 2H	OCTAGONAL RING: SOFT IRON	1" - 24" (25 - 600)	GAspl + GAsps GLbs + GLwb GLspl + GLps CHwb CHps	1, 5, 25
A13	N1AS	WBF	1500	(RTJ)	1.5	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - HIGH PRESSURE BOILER FEED WATER	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW	-20 400	255.3 173.4	FV (MAX 160 DEG C)	A	B7 / 2H	OCTAGONAL RING: SOFT IRON	1" - 24" (25 - 600)	GAspl GLwb GLps CHwb CHps	1, 5, 25, 26
A12	N3AG	WBF, SC110, S120	1500	RTJ	3.0	CS	CS ASME SA-106 Gr.B (impact tested) <=24" >24" ASME SA-671 GR.CC60 CL.32, S2	UTILITY - BOILER CODE ASME B31.1 BLOWDOWN BOILER FEED WATER	B31.1	NO	NO	B31.1		5 (HF)	1.1	LTCS ASME SA-350 GR. LF2	BW, FL	-20 150 340	189.5 189.5 139	FV (MAX 160 DEG C)	A	B7 / 2H	OCTAGONAL RING: SOFT IRON	1" - 24" (25 - 600)	GA GL CH	1, 5, 25
A13	N3AS	SC42, WBF	1500	RTJ	3.0	CS	CS ASTM A106 Gr.B (impact tested) <=24" >24" ASTM A671 GR.CC60 CL.32, S2	UTILITY - CONDENSATE, BOILER FEED WATER	B31.3	NO	NO	B31.3	D, NFS, ETFS	5 (HF)	1.1	LTCS ASTM A350 GR. LF2	BW, FL	-20 400	255.3 173.4	FV (MAX 160 DEG C)	A	B7 / 2H	OCTAGONAL RING: SOFT IRON	1" - 24" (25 - 600)	GA GL CH	1, 5
A13	P1ES	S110	2500	(RTJ)	1.5	2 1/4CR	2 1/4 Cr-1 Mo ASTM A335 GR. P22 <=24" >24" ASTM A691 GR.2 1/4CR CL.42	UTILITY - HIGH HIGH PRESSURE STEAM VERY HIGH PRESSURE STEAM	B31.3	NO	NO	YES	D, NFS, ETFS	5 (HF)	1.10	2 1/4 Cr-1 Mo ASTM A182 GR.F22 CL.3	BW	-20 540	388.3 135.0	FV (MAX 320 DEG C)	A	B16 / 7	OCTAGONAL RING: 316 SS	1" - 30" (25 - 750)	GLbs + GLwb + GLeb GLspl + GLps + GLeb GAspl + GAsps + GLeb CHwb CHps	1, 5, 16, 25, 26
A11	P18G	S110	2500	(RTJ)	1.5	9CR	9 Cr-1 Mo - V ASME SA-335 GR. P91 <=24" >24" ASME SA-691 GR. 91 CL.42	UTILITY - HIGH HIGH PRESSURE STEAM VERY HIGH PRESSURE STEAM	B31.1	NO	NO	YES		5 (HF)	1.15	9 Cr-1 Mo - V ASME SA-182 GR. F91	BW	9 540	135.0 135.0	FV (MAX 160 DEG C)	A	B16 / 7	OCTAGONAL RING: 316 SS	1" - 30" (25 - 750)	GLbs + GLwb + GLeb GLspl + GLps + GLeb GAspl + GAsps + GLeb CHwb CHps	1, 5, 16, 25, 26
A13	P18S	S110, S18, S42, WBF	2500	(RTJ)	1.5	9CR	9 Cr-1 Mo - V ASME SA-335 GR. P91 <=24" >24" ASME SA-691 GR. 91 CL.42	UTILITY - HIGH HIGH PRESSURE STEAM VERY HIGH PRESSURE STEAM	B31.3	NO	NO	YES	D, NFS, ETFS	5 (HF)	1.15	9 Cr-1 Mo - V ASTM S182 GR. F91	BW	9 540	135.0 135.0	FV (MAX 160 DEG C)	A	B16 / 7	OCTAGONAL RING: 316 SS	1" - 30" (25 - 750)	GLbs + GLwb + GLeb GLspl + GLps + GLeb GAspl + GAsps + GLeb CHwb CHps	1, 5, 16, 25, 26
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ATTACHMENT 1.0  
PIPE CLASS SERVICE INDEX

REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CODES (NOTE 3)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 1)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MATL.	CONST.N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE
A12	Q0TU	WF	LAP JOINT 125/150	FF	0.0	HDPE	HDPE PE100 (SDR11 / PN16)	UTILITY - UNDERGROUND WATER SERVICE FIREWATER	EN 12201	NO	NO	NO		AL BRONZE	-	HDPE PE100	BUTT FUSION / ELECTRO FUSION	-20 20	16	FV	-	A307-B / A563-A (GALV)	RUBBER (NBR OR CHLOROPRENE) FLAT RING PROFILE TYPE WITH INTEGRAL INNER O RING AND METAL INSERT.	2" - 24" (60 - 600)	GA CH	1, 23
A12	Q0TW1	DCC, DO, DOC, DS, DSW, WW	LAP JOINT 125/150	FF	0.0	HDPE	HDPE PE100 (SDR11 / PN16)	UTILITY - UNDERGROUND WATER SERVICE SANITARY WATER SEWERS ONLY WATER SEWERS SURFACE CONTAMINATED WATER CLEAN STORM WATER ACCIDENTAL OIL CONTAMINATED SEWER	EN 12201	NO	NO	NO		8 (13CR / HF) BUNA N / EPOXY LINED / AL BRONZE LINED	-	HDPE PE100	BUTT FUSION / ELECTRO FUSION	-20 40	10.0 10.0		-		RUBBER (NBR OR CHLOROPRENE) FLAT RING PROFILE TYPE WITH INTEGRAL INNER O RING AND METAL INSERT.	2" - 24" (60 - 600)	BFdbI GA CH	1, 2, 11, 22
A8	S0CW	WCI, WCR, WCS, WS	125/150	FF	0.0	GRE	ASTM D2996, 11FE GLASS FIBRE REINFORCED EPOXY BISPHENOL A AMINE CURED RESIN	UTILITY - UNDERGROUND WATER SERVICE COOLING WATER	ISO 14692	NO	NO	NO		BUNA-N / EPOXY LINED. AL BRONZE DISC / BUNA-N SEAT	-	ASTM D2996, 11FE GLASS FIBRE REINFORCED EPOXY BISPHENOL A AMINE CURED RESIN	ADHESIVE BONDED, BUTT & WRAP, FL	-20 50	10.0	FV	B	A307-B / A563-A (GALV)	RUBBER (NBR OR CHLOROPRENE) FLAT RING PROFILE TYPE WITH INTEGRAL INNER O RING AND METAL INSERT.	2" - 60" (50 - 1800)	BFdbI GA CH	1, 2
A13	S0SY	CIN	125/150	FF	0.0	CPVC	CPVC - ASTM D1784 & D1785	UTILITY - CHEMICAL DOSING	B31.3	NO	NO	NO	D, NFS	CPVC	-	CPVC-D2467 & D1785	SOLVENT WELD, FL	-20 65	10.5 7.7		B	A307-B / A563 A	BUTYL RUBBER	1/2" - 3" (15 - 80)	BA PL BF CH	1, 14, 15, 27
A14	S1RU (GROOVED)	DS, WF, WFF	150	FF	1.5	GALV CS	CS ASTM A106 GR.B (GALV.) (impact tested) <=24" USING VICTAULIC GROOVE SYSTEM	UTILITY - ABOVE GROUND WATER SERVICE FIRE WATER SPRINKLER SYSTEM	B31.3	NO	NO	NO	D, NFS	8 (13CR / HF)	-	CS ASTM A105N (GALV.) USING VICTAULIC GROOVE SYSTEM	FL, GRV	-20 70	16.0 16.0	PV	A	A307-B / A563-A (GALV)	SYN. FIBRE / OIL RESISTANT BINDER	1" - 18" (25 - 450)	GA GL CH	1, 10
A13	U0LY	CH	TUBING	-	0.0	SS316	SS ASTM A269 TP316	TUBING - CHEMICAL INJECTION	B31.3	NO	NO	NO	D, NFS	PTFE / SS316	-	-	COMP.	-50 150	135	-	A	-	-	1/4" - 1" (8 - 25)	BA CH GL	1, 5, 27, 29



ATTACHMENT 1.0  
PIPE CLASS SERVICE INDEX

REV.	PROJECT PIPE CLASS REF	PROJECT FLUID CLASS (NOTE 31)	CLASS RATING	FLANGE FACE TYPE	C/A mm	GEN MATERIAL REF	PIPE MATERIAL	SERVICE DESCRIPTION	ASME CODE	HIC	NACE MR0103	PWHT (NOTE 13)	ASME CAT	API 600 VALVE TRIM	ASME B16.5 MAT'L GROUP	FLANGE MATL.	CONST.N	DESIGN TEMP RANGE (Deg C) (Note 3)	DESIGN PRESS RANGE (Barg) (Note 3)	Vacuum (Note 3)	PACKING TYPE	BOLTING	GASKET (S)	SIZE RANGE NPS (mm)	VALVE TYPE	NOTE
		<b>VALVE</b> BA = Ball BAeb = Ball Valve Extended Bonnet BAmc = Ball valve, metal seated, cavity filled BFdb = Butterfly Valve Double Offset BFtp = Butterfly Valve Triple Offset BFspl = Butterfly Spring Loaded Glands CH = Check CHPs = Check Pressure Seal CHwb = Check Welded Bonnet DIAP = Diaphragm GA = Gate GAbs = Gate Bellow sealed GAeb = Gate Extended Bonnet GAspl = Gate Spring Loaded Glands GAPs = Gate Pressure Seal GL = Globe GLbs = Globe Bellow sealed GLEb = Globe Extended Bonnet GLspl = Globe Spring Loaded Glands GLPs = Globe Pressure Seal GLwb = Globe Welded Bonnet N = Needle PL = Plug PS = Piston Valve					<b>MATERIAL</b> CS = Carbon steel GR = Grooved end for Victaulic coupling joint GRP = Reinforced Thermosetting Resin Plastic HAS = Hastelloy HDPE = High Density Polyethylene ITCS = Impact Test Carbon Steel KCS = Killed Carbon Steel LTCS = Low Temperature Carbon Steel (Impact tested). NAF = Non Asbestos Fibre PVC = Poly Vinyl Chloride PE = Polyethylene PTFE = Poly Tetra Fluoro Ethylene SS = Stainless Steel					<b>ASME CAT</b> D = Category D Fluid Service NFS = Normal Fluid Service ETFS = Elevated Temperature Fluid Service				<b>CONSTRUCTION</b> BW = Buttweld COMP. = Compression joint FL = Flange GRV = Grooved JT = Jacketed system LJ = Lap Joint OSF = Oversized Flange for Jacketed system SOL = Solvent weld SW = Socket weld THD = Thread WN = Weldneck Flange				<b>GASKET TYPE</b> RTJ = Ring Joint SPW = Spiral Wound						
		<b>HOLDS</b> DELETED. DELETED. DELETED. DELETED. DELETED. <b>NOTES</b> Additional valves shall be added in individual pipe classes when specified. Use of soft seated Butterfly valves shall be limited to maximum temperature of 200C (392°F). Full vacuum (FV) classes shall be engineered for full vacuum to design conditions as listed, except where noted (eg. J3DP4). Partial vacuum (PV) classes shall be calculated for vacuum only. Where the 5th digit of the Project Pipe Class Number = 4 for vacuum service, the Process shall be protected from contamination due to external ingress, by either bellows sealed or spring loaded glands, suitable for full vacuum. Valves shall be tested for vacuum as per ASME SEC.V, ART.10 (HOOD Method). Carbon steel and Low alloy steel pipe shall be supplied seamless in sizes up to and including 24" NB. Weld seam with joint efficiency of 1.0 may be considered at size 26" NB, and above. Stainless steel and other exotic material pipe shall be supplied seamless in sizes up to and including 10" NB. Weld seam with joint efficiency of 1.0 at size 12" NB. and above (unless specifically advised). Material shall have 0.04% Min. carbon content. Low carbon grade Stainless Steel Material is not acceptable. Where Stainless steel is referenced as 304 / 304L and 316 / 316L, this shall be supplied dual-certified to offer mechanical strength of standard grade 304 / 316 with chemical composition of 304L / 316L respectively. S1RU shall be used for both wet and dry (before and after the deluge valve) aboveground fire water service. Occasional short duration temperature excursions to maximum 65 °C are acceptable for gravity drain service only. Pressurised service temperature is limited to 50°C. Underground buried piping shall be externally protected in accordance with the Project issue of the " Coating and Wrapping of Buried Pipework" specification. PWHT of welds for Wet H2S, Caustic and Amine services shall be in accordance with Project specifications for material requirements of pressurised piping. For Caustic and Amine service PWHT shall apply to all welds both in component manufacture and site fabrication. CPVC to be provided with long term UV protection. Splash guard shall be provided for all flange connections. Do not use flanged end valves with valve body material of ASTM A217 Gr.WC6 for temperature above 538°C. Design temperature and pressure is reduced to suit valve casting material ASTM A352 Gr.LCB . Gate and globe valves to be bellows sealed below 2"; and spring loaded glands 2" and above. DELETED. DELETED. Pipe class shall be applied in-line with the operating pressure / temperature limits specified per specification Service Definitions and General Requirements, 7650-8440-SP-100-0019. HDPE piping shall be selected for maximum design conditions. CONTRACTOR shall identify and consider for any potential upset conditions and their expected durations. Where HDPE is used belowground for firewater service, the PN rating shall be based on the maximum coincident operating conditions, as a minimum. Refer to ASME B31.3 for the relevant ASTM materials for impact testing requirements of austenitic stainless steel at design minimum temperatures of -101 deg C and lower. Valves to include seal welded bonnet below 2"; valves to include pressure sealed bonnets 2" and above. Flanges shall only be allowed where indicated on P & I Diagram. The use of soft seated ball valves is restricted to Max. Design Temperature of 200°C. Gasket ID to match pipe bore Tubing shall be run in cable tray. Pipe class is not suitable for hydrocarbon service. a.Instrument air piping shall be designed in carbon steel from the Air Compressor package to the battery limit. After the battery limit filters, up to the instrument connections, stainless steel piping shall be applied. b.Plant Air piping shall be designed in carbon steel. For special purposes stainless steel piping may be applied. c.Nitrogen piping shall be designed in carbon steel. For special purposes stainless steel piping may be applied. Project fluid codes in accordance with Equipment Numbering Procedure, 7650-8820-PR-100-0004 For Firewater service buried / underground, the piping components allowed from this pipe class shall be restricted to a single transition spool for connection to the HDPE underground firewater piping. Spool shall be coated and wrapped as per 7650-8440-SP-100-0002 "Protective Paint and Coatings Pipe class may also be used underground. Pipe used underground shall be wrapped in accordance with 7650-8440-SP-100-0002. Bolted or screwed connections, valves, or in-line instruments shall not be used underground. Underground pipe wall thicknesses shall be checked for soil, settlement cover and traffic load. Metal-seated, cavity-filled ball valves are included in these pipe classes for use only in PyOil service where it is expected that particles in the fluid would cause problems for default pipe class valve choice.																								





**IPMT Specification – Piping**  
**PIPING MATERIAL CLASS SERVICE INDEX AND GENERAL**  
**NOTES**

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**ATTACHMENT 2.0 – STANDARD HOOK-UP ASSEMBLY ID / PIPE CLASS CROSS REFERENCE MATRIX**

**ATTACHMENT 2.0**

PIPING MATERIALS CLASS SERVICE INDEX

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**STANDARD HOOK-UP ASSEMBLY ID / PIPE CLASS CROSS REFERENCE MATRIX**

Section Per Doc 7650-8230-SP-100-0006	8.1			8.2	8.3	8.4	8.5		8.6	8.7 & 8.8		8.9	8.10	
Pipe Class	Process Vents & Drains			Hydro-static Vents & Drains	Pressure Instrument Connections	Pressure Instrument	Temperature Instrument Connections		Orifice Flange Connections	Level Instrument Connections Level gauges		Level Transmitter	Diaphragm type Pressure Gauge & Transmitter Connections	
	Header size			Header size	All Headers sizes inc. Stand pipes	On EQPT.	Header size NPS 4" min.		Flange size 2" min.	On EQPT.	On Stand Pipe	On EQPT.	On EQPT.	On Pipe
	1"-10"	12"-20"	≥ 24"	≥ 1"			Horizontal	Vertical						
A0JA	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A0JD	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A0JM	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A0JZ3	*VD03 / D01	*VD03*/VD02 D01 / D02	*VD02 / D02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A0JW	VD03	-	-	H01	P01	PE01	T01	T02	F02	LG01	LG04	-	PD01	PD02
A0LD	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A0LY	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A04Y	VD03	-	-	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A1AA	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A1AH3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A1AP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A1AP4	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A1AS	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A1AS4	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A1DP	VD03	VD03/VD02	VD02	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A1DH3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A1GP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A12Y	VD03	-	-	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A3AN3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A3AP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A3AP4	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A3AS	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A3AU	VD01	VD01/VD02	VD02	H01	P02	PE01	T01	T02	F01	LG02	LG04	LD01	PD01	PD02
A3AV	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
A3AW	VD01	VD01/VD02	VD02	H01	P02	PE01	T01	T02	F01	LG02	LG04	LD01	PD01	PD02
A3GP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
A6AC	VD08	VD08/VD08	VD08	H01	P05	PE04	T01	T02	F02	LG01	LG04	LD01	PD07	PD08
A6AV	VD02	-	-	H02	-	PE01	-	-	-	-	-	-	-	-
B0JA	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B0JD	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B0JP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B0JZ3	*VD03 / D01	*VD03*/VD02 D01 / D02	*VD02 / D02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B0LY	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B0MH3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02

**STANDARD HOOK-UP ASSEMBLY ID / PIPE CLASS CROSS REFERENCE MATRIX**

Section Per Doc 7650-8230-SP-100-0006	8.1			8.2	8.3	8.4	8.5		8.6	8.7 & 8.8		8.9	8.10	
Pipe Class	Process Vents & Drains			Hydro-static Vents & Drains	Pressure Instrument Connections	Pressure Instrument	Temperature Instrument Connections		Orifice Flange Connections	Level Instrument Connections Level gauges		Level Transmitter	Diaphragm type Pressure Gauge & Transmitter Connections	
	Header size			Header size	All Headers sizes inc. Stand pipes	On EQPT.	Header size NPS 4" min.		Flange size 2" min.	On EQPT.	On Stand Pipe	On EQPT.	On EQPT.	On Pipe
	1"-10"	12"-20"	≥ 24"	≥ 1"			Horizontal	Vertical						
B1AA	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B1AH3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B1AP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B1AS	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B1DH2	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B1DH3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B1DP3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B1GH3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B1GP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B3AN3	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B3AP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B3AP4	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
B3AS	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B3AV	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B3AW	VD01	VD01/VD02	VD02	H01	P02	PE01	T01	T02	F01	LG02	LG04	LD01	PD01	PD02
B3DS	VD03	VD03/VD02	VD02	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
B3MP3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
D0JZ3	*VD03 / D01	*VD03/*VD02 D01 / D02	*VD02 / D02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
D0LY	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
D1AA	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
D1AP3	VD03	VD03/VD02	VD02	H01	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
D1AS	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
D3AS	VD03	VD03/VD02	VD02	H01	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
E0JZ3	*VD06 / D03	*VD06/*VD07 D03 / D04	*VD07 / D04	H02	P04	PE03	T03	T04	F04	LG06	LG07	LD03	PD05	PD06
F0JZ3	*VD06 / D03	*VD06/*VD07 D03 / D04	*VD07 / D04	H02	P04	PE03	T03	T04	F04	LG06	LG07	LD03	PD05	PD06
J3DP4	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
J3EP4	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
L1DS	VD04	VD04/VD05	VD05	H02	P03	PE02	T01	T02	F03	LG03	LG05	LD02	PD03	PD04
M1DS	VD04	VD04/VD05	VD05	H02	P03	PE02	T01	T02	F03	LG03	LG05	LD02	PD03	PD04
M1GP3	VD03	VD03/VD02	VD02	H02	P01	PE01	T03	T04	F02	LG01	LG04	LD01	PD01	PD02
M1GP5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M3AS	VD03	VD03/VD02	VD02	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
N0LD	VD03	-	-	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
N0LY	VD03	-	-	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02

**ATTACHMENT 2.0**

PIPING MATERIALS CLASS SERVICE INDEX

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**STANDARD HOOK-UP ASSEMBLY ID / PIPE CLASS CROSS REFERENCE MATRIX**

Section Per Doc 7650-8230-SP-100-0006	8.1			8.2	8.3	8.4	8.5		8.6	8.7 & 8.8		8.9	8.10	
Pipe Class	Process Vents & Drains			Hydro-static Vents & Drains	Pressure Instrument Connections	Pressure Instrument	Temperature Instrument Connections		Orifice Flange Connections	Level Instrument Connections Level gauges		Level Transmitter	Diaphragm type Pressure Gauge & Transmitter Connections	
	Header size			Header size	All Headers sizes inc. Stand pipes	On EQPT.	Header size NPS 4" min.		Flange size 2" min.	On EQPT.	On Stand Pipe	On EQPT.	On EQPT.	On Pipe
	1"-10"	12"-20"	≥ 24"	≥ 1"			Horizontal	Vertical						
N1AG	VD03	VD03/VD02	VD02	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
N1AS	VD03	VD03/VD02	VD02	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
N3AG	VD03	VD03/VD02	VD02	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
N3AS	VD03	VD03/VD02	VD02	H02	P01	PE01	T01	T02	F02	LG01	LG04	LD01	PD01	PD02
P1ES	VD04	VD04/VD05	VD05	H02	P03	PE02	T01	T02	F03	LG03	LG05	LD02	PD03	PD04
P18G	VD04	VD04/VD05	VD05	H02	P03	PE02	T01	T02	F03	LG03	LG05	LD02	PD03	PD04
P18S	VD04	VD04/VD05	VD05	H02	P03	PE02	T01	T02	F03	LG03	LG05	LD02	PD03	PD04
QOTU	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Q0TW1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S0CW	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S0SY	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S1RU	-	-	-	H03	P02	-	T05	T06	-	-	-	-	-	-

Note

\* Use for Vent only.